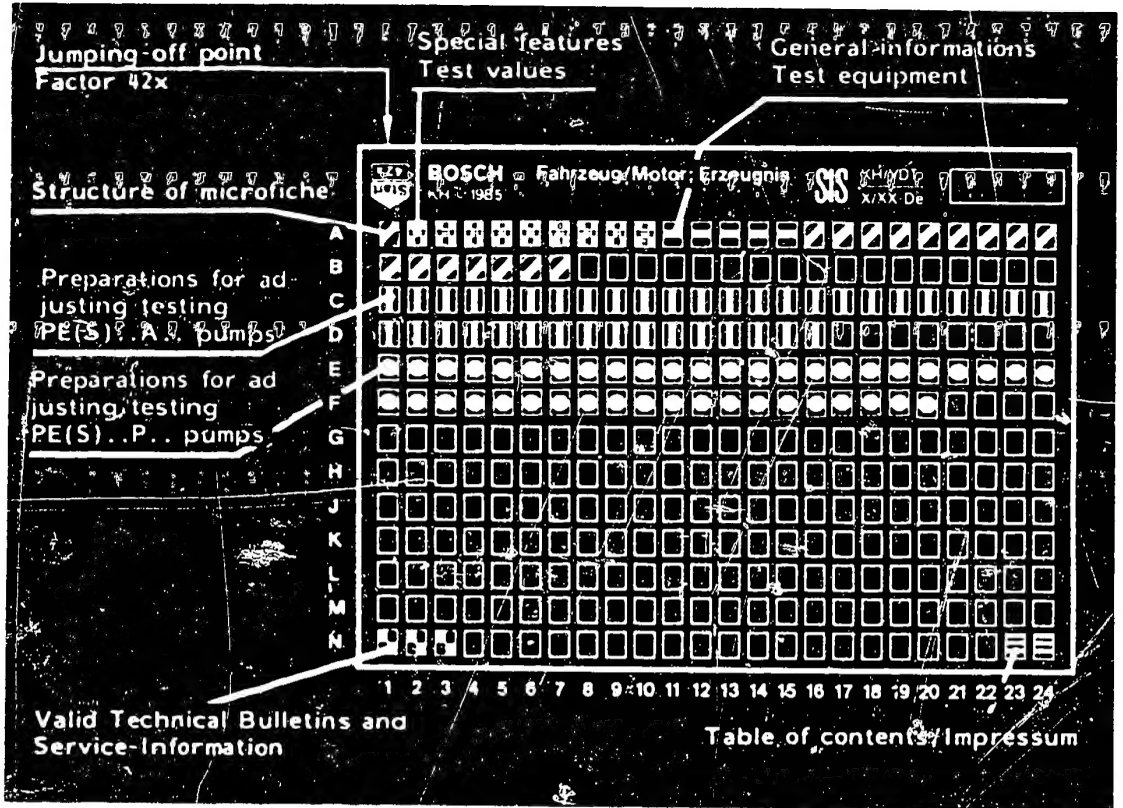
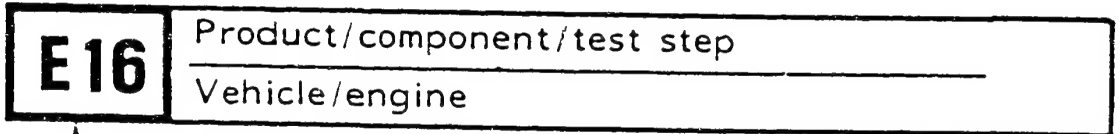


# Structure of microfiche



1. Read from left to right
2. Title of microfiche (appears on each coordinate)

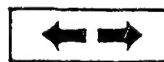


↑ Coordinate

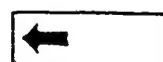
3. Limits of section



Beginning



Mid-section



End



One-page section

4. Purely vehicle-specific passages in the text are marked with a vertical bar.

**A1**

## 1. Special features

This microcard contains the testing and adjusting of fuel-injection pumps of sizes PE(S)..A.. and PE(S)..P.. on Bosch injection-pump test benches.

The "Notes on testing of injection pumps" listed as of Coordinate A3 apply to both injection pump series. The further sections are divided according to PE(S)..A.. and PE(S)..P...

## 2. Test specifications

The test specifications for fuel-injection equipment are contained in the test specifications of microcard WP.. (table of contents WP-00).

The test specifications for governors and timing devices alone are listed on microcards WP-451 to WP-453.

### 2.1 Tightening torques

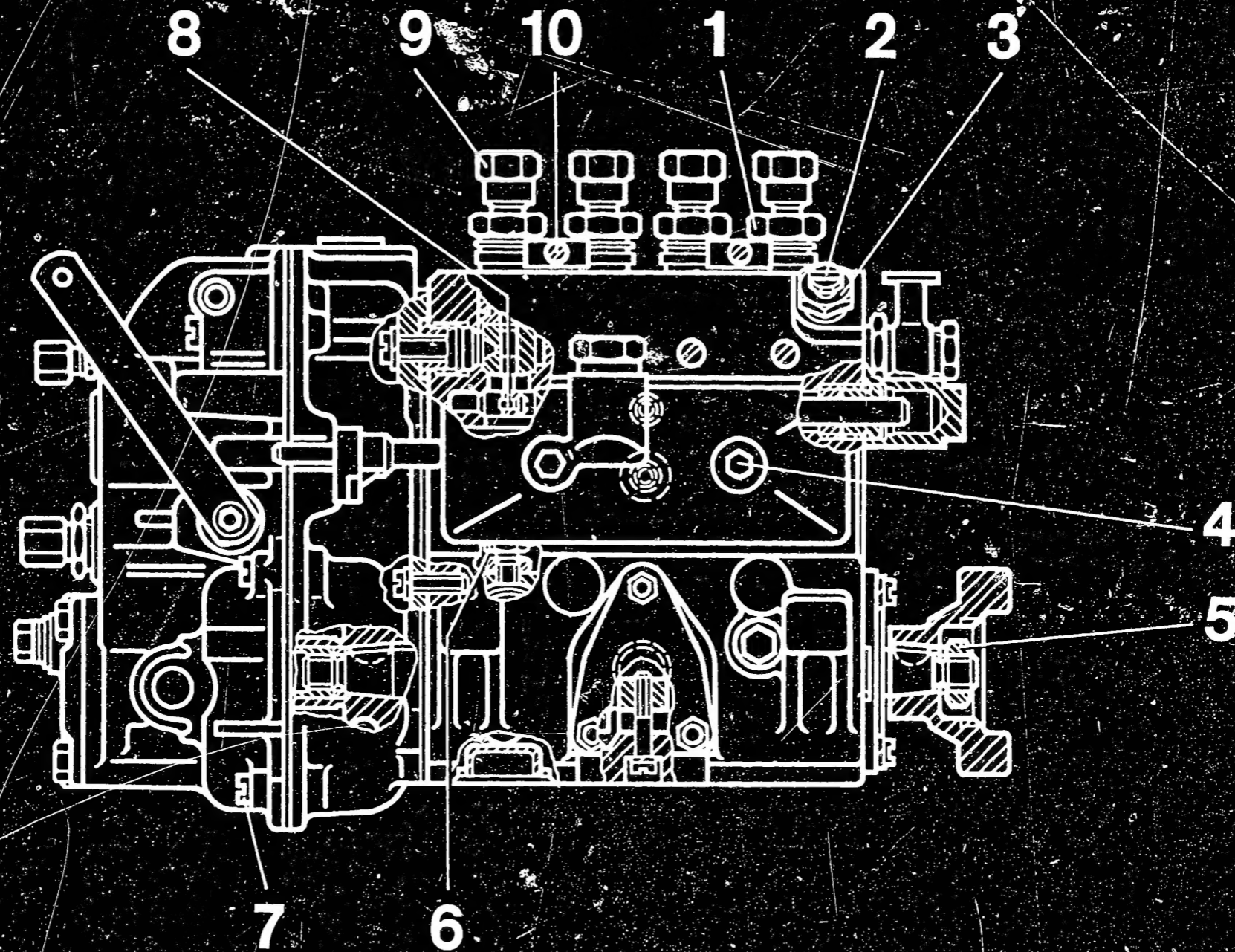
Screws, nuts etc. are itemized on drawings of PE(S)..A .. - and PE(S)..P.. pumps on Coordinates A3/A4 and A7/A8, respectively.

These items are repeated below the drawings together with the coordinates on which you can find the tightening torque.

**A2**

Special features/test specifications  
Adjusting/testing PE(S)..A../PE(S)..P..





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2.1.1 Tightening torques for PE(S)..A.. pumps

Item	Coordinates
1 ... 6	A 5
7 ... 10	A 6

**A3**

Test specifications  
Adjusting/testing PE(S)..A../PE(S)..P..



**A4**

Test specifications  
Adjusting/testing PE(S)..A../PE(S)..P..



## Tightening torques

### Item 1 - delivery-valve holder

#### Double seal

Model	Delivery-valve holder w/o id. groove	Delivery-valve hold. with id. groove
	Nm	Nm
PE(S)..A..C..	45-0-45-0-45...50	-
PE(S)..A..D..	-	40-0-40-0-40...45* 30-0-30-0-33...37**

\* for PE(S) 2..6A..D..

\*\* for PE(S) 8..12A..D..

Item 2 - Bleeder screw 4 ... 5 Nm

Item 3 - Threaded bushing 20 ... 30 Nm

Item 4 - Spring-chamber cover  
fastening screws 4 ... 5 Nm

Item 5 - Coupling

Cone dia.	Thread	Nm
17 mm	M 12	60 ... 70
20 mm	M 14 x 1.5	80 ... 90

Item 6 - Roller tappet  
hexagon nut 15 ... 25 Nm

**A5**

Test specifications

Adjusting/testing (PE(S)..A../PE(S)..P..





Tightening torques (continued)

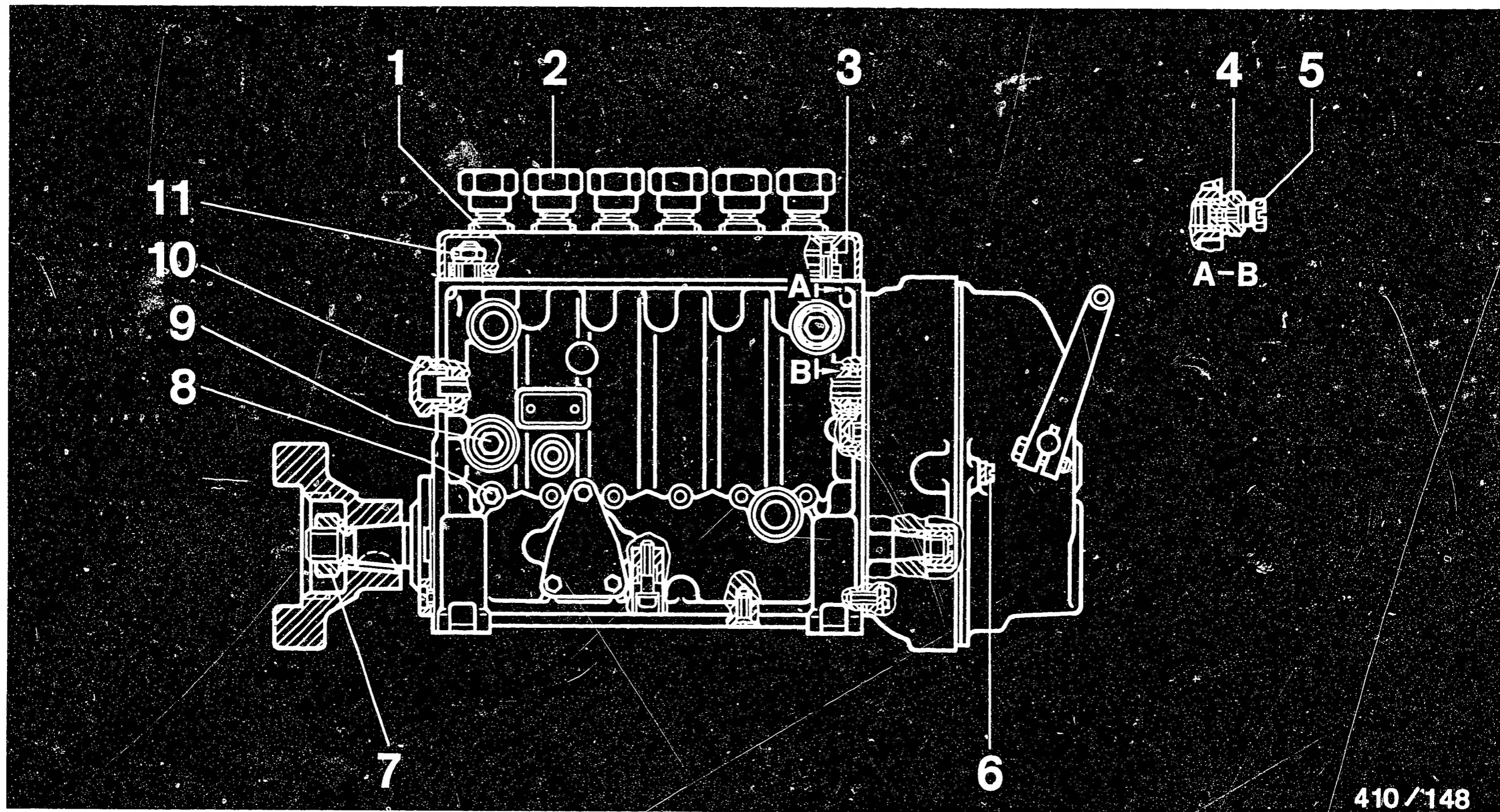
Item 7 - Governor cover fastening screws	M6	5 ... 7 Nm
	M8	11 ... 16 Nm
Item 8 - Clamping screw		3 ... 4 Nm
Item 9 - Union nut		max. 25 Nm
Item 10 - Fillister-head screw		5...6.5 Nm

**A6**

Test specifications

Adjusting/testing PE(S)..A../PE(S)..P..



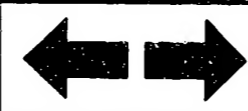


410 / 148


2.1.2 Tightening torques for PE(S)..P.. pumps

Item	Coordinate
1...6	A 9
7...11	A 10

**A7** Test specifications  
 Adjusting/testing PE(S)..A../PE(S)..P..



**A8** Test specifications  
 Adjusting/testing PE(S)..A../PE(S)..P..



4.3 Test benches and test equipment assigned to models of injection pump

Pump model: PE(S)..A.., PE(S)..AM..

Approved pump test benches	Specified				1 Inlet pressure
	cal.fuel-injection tubing	cal.nozzle-and-holder assemblies			2 Overflow valve/Part No.
Model designation (No. of measuring points) Remarks, restrictions	1 Part No.	Model	cal. nozzle	perforated plate	3 Remarks
	2 O.D. x wall thickness x length	1 Part No./ mod.desig.	1 Part No./ mod.desig.	1 Part No.	
	3 Delivery-valve holder thread	2 Opening pressure	2 Type	2 Bore dia.	
	4 Remarks				
EFEP 375.. (8) *	1 1 680 750 014	1 0681 343009	1 0681 443014	---	1 1.0 bar (kp/cm <sup>2</sup> )
EFEP 385.. (12) *	2 6 x 2 x 600 mm	EF 8511/9A	EFEP 182		2 1 417 413 000 or as given in test-specification sheet for pump
EFEP 390.. (12) *	3 M 12 x 1.5	2 172+3 bar	2 S pintle nozzle		3 Scavenging: with PE(S)..A..D.. and PE(S)..AM..D.. all versions
EFEP 410.. (12) *	4 possible deviations (given on test-specification sheet):	(175+3 kp/cm <sup>2</sup> )			with all other PE(S)..A.. and PE(S)..AM.. as of 8 mm plunger-and-barrel assembly diameter
ESP 270.. (8)	1 1 680 750 015				
EFEP 500.. (8)	2 6 x 1.5 x 600 mm				
EFEP 515.. (12)	3 M 14 x 1.5				
EFEP 615.. (12)	1 1 680 750 008				
* with large flywheel	2 6 x 2 x 600 mm				
1 686 609 057 all injection-pump versions;	3 M 14 x 1.5				
	1 9 681 230 702				
	2 6 x 2 x 600				
	3 9/16" - 18				
	1 9 681 230 706				
	2 6 x 2 x 600 mm				
	3 9/16" - 18 (Ermeto)				

**A17**

Test equipment

Adjusting/testing PE(S)..A../PE(S)..P..



**A18**

Test equipment

Adjusting/testing PE(S)..A../PE(S)..P..



Test benches and test equipment assigned to models of injection pump (continued)

Pump model: PE(S)..P.. (up to 11 mm plunger diameter)

Approved pump test benches	Specified				1 Inlet pressure
	cal.fuel-injection tubing	cal. nozzle-and-holder assemblies			
		Model	cal. nozzle	perforated plate	2 Overflow valve/ Part No.
Model designation (No. of measuring points) Remarks, restrictions	1 Part No. 2 O.D. x wall thickness x length 3 Delivery-valve holder thread 4 Remarks	1 Part No./ mod.desig. 2 Opening pressure	1 Part No./ mod.desig. 2 Type	1 Part No. 2 Bore dia.	3 Remarks
EFEP 410.. (12) 1) EFEP 375.. (8) * EFEP 385.. (12) * EFEP 390.. (12) * EPS 270.. (8) 2) EFEP 500.. (8) 2) EFEP 515.. (12) EFEP 615.. (12)	1 1 680 750 015 2 6 x 1.5 x 600 mm 3 M 14 x 1.5 4 possible deviations (given on test-specification sheet).	1 0 681 343 009 EFEP 8511/9A 2 172 + 3 bar (175+3 kp/cm <sup>2</sup> )	1 0 681 443014 EFEP 182 2 S pintle nozzle	----	1 1.5 bar (kp/cm <sup>2</sup> ) 2 1 417 413 025 or as given in test-specification sheet for pump 3 Scavenging
* with large flywheel 1 686 609 057 all injection pump versions; 1) up to PE(S) 8P 110 .. with large flywheel 2) up to PE(S) 6P 110..	1 9 681 230 724 2 6 x 1.5 x 750 mm 3 M 14 x 1.5	1 1 688 901 016 2 207 + 3 bar (211+3 kp/cm <sup>2</sup> )	1 0 688 901999	1 1 680 103095 2 0.5 mm dia.	

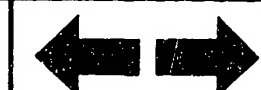
**A19**

Test equipment  
Adjusting/testing PE(S)..A../PE(S)..P..



**A20**

Test equipment  
Adjusting/testing PE(S)..A../PE(S)..P..



Test benches and test equipment assigned to models of injection pump (continued)

Pump model: PE(S)..P.. (as of 12 mm plunger diameter) - except PE(S)..P.. 7000 series

Approved pump test benches	Specified				1 Inlet pressure
	cal. fuel-injection tubing	cal. nozzle-and-holder assemblies			2 Overflow valve/ Part No.
Model designation (No. of measuring points)	1 Part No.	Model	cal. nozzle	perforated plate	3 Remarks
Remarks, restrictions	2 O.D. x wall thickness x length	1 Part No./ mod. desig.	1 Part No./ mod. desig.	1 Part No. 2 Bore dia.	
	3 Delivery-valve holder thread	2 Opening pressure	2 Type		
	4 Remarks				
EFEP 375.. (8) 1) * all pump versions	1 1 680 750 060	1 0 681 443022 EFEP 215 C.	1 0 681 443021 EFEP 216A	-----	1 1.5 bar (kp/cm <sup>2</sup> )
EFEP 385.. (12) 2) * all pump versions	2 8 x 2 x 1000 mm	2 172 + 3 bar (175+3kp/cm <sup>2</sup> )	2 T pintle nozzle		2 1 417 413 025 or as given in test- specification sheet for pump
EFEP 390.. (12) 3) * all pump versions	3 M 14 x 1.5				3 Scavenging
EFEP 410.. (12) 1) * up to PE(S) 8P 130..	4 possible deviations (given on test-spe- cification sheet)				
EFEP 410.. (12) 1) * up to PE(S) 8P 130..	1 1 680 750 061	1 0 681 443022 EFEP 215 C	1 0 681 443021 EFEP 216A	-----	
EPS 270.. (8) 1) up to PE(S) 6P 120..	2 8 x 2 x 1000 mm	2 172 + 3 bar	2 T pintle nozzle		
EFEP 500.. (8) 1) up to PE(S) 6P 120..	3 M 16 x 1.5				
EFEP 500.. (8) 1) up to PE(S) 6P 120..	1 1 680 750 067	1 1 688 901019	1 1 688 901999	1 1 680 103098	
EFEP 515.. (12) 4) all pump versions	2 6 x 1.5 x 1000 mm	2 207 + 3 bar (211 + 3kp/cm <sup>2</sup> )		2 0.8 mm dia.	
EFEP 515.. (12) 4) all pump versions	3 M 14 x 1.5				
EFEP 615.. (12) 5) all pump versions	1 1 680 750 074	1 1 688 901019			
* with large flywheel 1 686 609 057	2 6 x 1.5 x 1000 mm	2 207 + 3 bar (211 + 3kp/cm <sup>2</sup> )			
	3 M 16 x 1.5				

Continued on A18/A19

**A21**

Test equipment

Adjusting/testing PE(S)..A../PE(S)..P..



**A22**

Test equipment

Adjusting/testing PE(S)..A../PE(S)..P..



Test benches and test equipment assigned to models of injection pump (continued)  
 Pump model: PE(S)..P.. (as of 12 mm plunger diameter) - except PE(S)..P.. 7000 series

Approved pump test benches	Specified				1 Inlet pressure
	cal.fuel-injection tubing	cal. nozzle-and-holder assemblies			2 Overflow valve/ Part No.
Model designation (No. of measuring points) Remarks, restrictions	1 Part No. 2 O.D. x wall thickness x length 3 Delivery-valve holder thread 4 Remarks	Model 1 Part No./ mod.desig. 2 Opening pressure	cal. nozzle 1 Part No./ mod.desig. 2 Type	perforated plate 1 Part No. 2 Bore dia.	3 Remarks
If calibrating-nozzle holders are to be used with perforated plate, the following applies: 1) up to PE(S) 6 P 120.. 2) up to PE(S) 8 P 120.. 3) up to PE(S)12 P 120.. 4 up to PE(S) 8 P 130.. 5) all injection pump versions	1 1 680 750 015 2 6 x 1.5 x 600 mm 3 M 14 x 1.5	1 1 688 901019 2 207 + 3 bar	1 1 688 901999	1 1 680 103098 2 0.8 mm dia.. and 1 1 680 107096 2 0.6 mm dia.	
	1 1 680 750 026 2 6 x 1.5 x 600 mm 3 M 14 x 1.5 together with connect- ing piece 1 683 391 118 9/16" x 18 1 1 680 750 074 2 6 x 1.5 x 1000 mm 3 M 16 x 1.5	1 0 681 443022 EFEP 215 C 2 172 + 3 bar	1 1 688 901999	1 1 680 103098 2 0.8 mm dia.	

**A23**

Test equipment  
 Adjusting/testing PE(S)..A../PE(S)..P..



**A24**

Test equipment  
 Adjusting/testing PE(S)..A../PE(S)..P..





Test benches and test equipment assigned to models of injection pump (continued)

Pump model: PE(S)..P.. 7000 series (as of 12 mm plunger diameter)

Approved pump test benches	Specified				1 Inlet pressure
	cal.fuel-injection tubing	cal. nozzle-and-holder assemblies			2 Overflow valve/ Part No.
Model designation (No. of measuring points) Remarks, restrictions	1 Part No.	Model	cal. nozzle	perforated plate	3 Remarks
	2 O.D. x wall thickness x length	1 Part No./ mod.desig.	1 Part No./ mod.desig.	1 Part No. 2 Bore dia.	
	3 Delivery-valve holder thread	2 Opening pressure	2 Type		
	4 Remarks				
EFEP 515.. (12) 1)	1 1 680 750 067	1 1 688 901019	1 1 688 901999	1 1 680 103098	1 1.5 bar (kp/cm <sup>2</sup> )
EFEP 615.. (12)	2 6 x 1.5 x 1000 mm	2 207 + 3 bar (211 + 3kp/cm <sup>2</sup> )		2 0.8 mm dia.	2 1 417 413 025 or as given in test- specification sheet for pump.
EFEP 385.. (12) 2)	3 M 14 x 1.5				3 Scavenging
EFEP 390.. (12) 2)	4 possible deviations (given on test-speci- fication sheet)				
1) up to PE(S) 8P 130..	1 1 680 750 015	1 1 688 901 019	1 1 688 901999	1 1 680 103098	
2) Approval of test bench models EFEP 385.. and EFEP 390.. each with large flywheel 1 686 609 057 for pumps up to PE(S)8P 130.. is limited to end of 1986 due to ISO standards.	2 6 x 1.5 x 600 mm	2 207 + 3 bar (211 + 3kp/cm <sup>2</sup> )		2 0.8 mm dia.	
	3 M 14 x 1.5				

**B1**

Test equipment

Adjusting/testing PE(S)..A../PE(S)..P..



**B2**

Test equipment

Adjusting/testing PE(S)..A../PE(S)..P..



#### 4.4 Test bench accessories

##### 4.4.1 Test bench accessories for PE(S)..A.. pumps

For clamping:

Clamping support	1 688 030 440
Clamping support	1 688 030 095
Universal clamping bracket	1 688 010 010
or	1 688 010 124
or	1 688 010 129
Locating bracket	1 688 010 033
Intermediate plate	1 682 308 010
Clamping support	1 688 030 021
Clamping flange	1 685 720 017
Reducing ring 72 mm diameter	1 680 103 007
Reducing ring 80 mm diameter	1 680 202 004
Reducing ring 85 mm diameter	1 680 202 005
Reducing ring 76.2 mm diameter	1 680 202 017
Clamping flange	1 685 720 014

For driving:

Coupling half, 17 mm cone diameter	1 416 430 012
Coupling half, 20 mm cone diameter	1 416 430 017
Puller	KDEP 1557

For measuring:

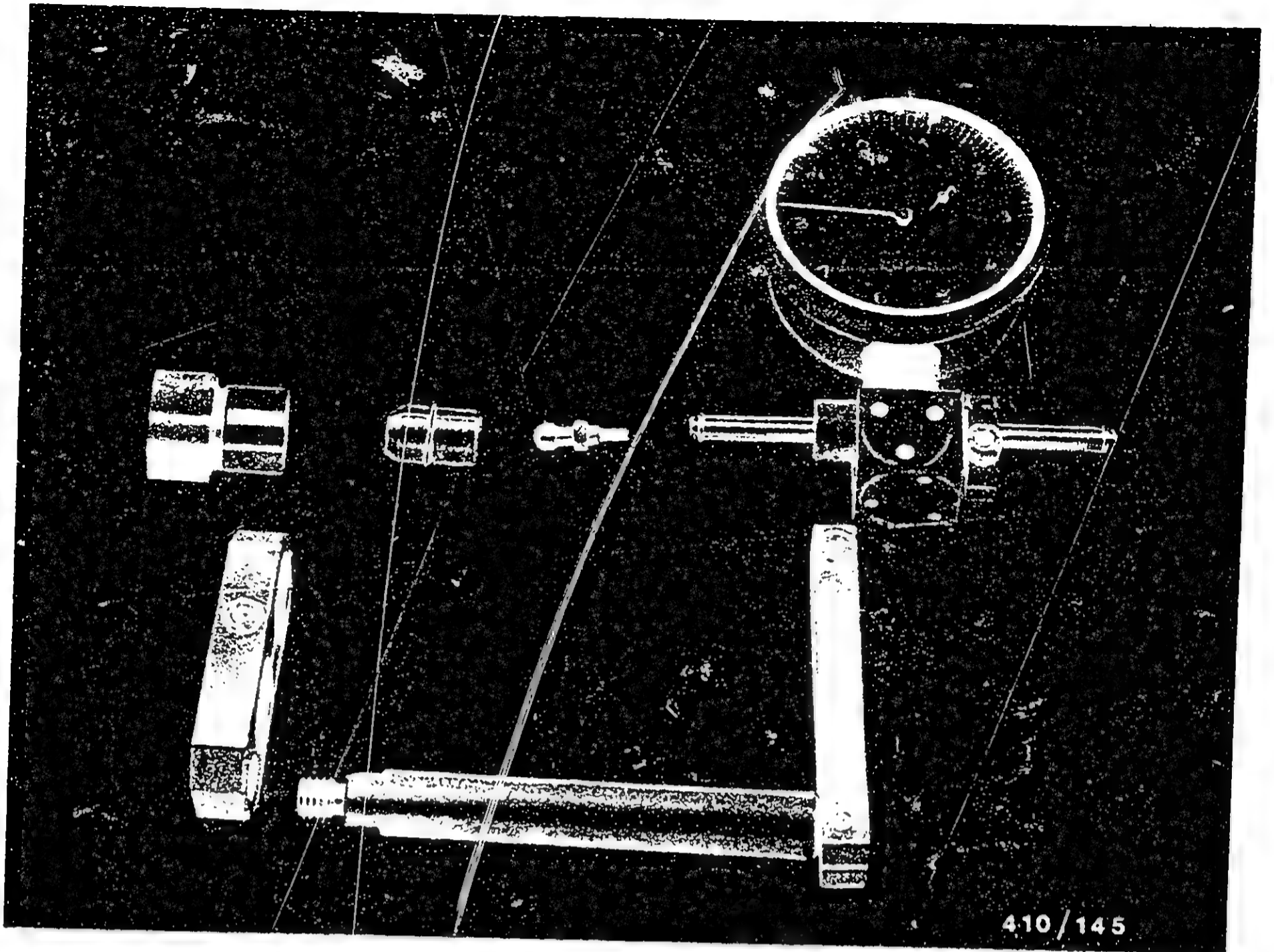
Control-rod-travel measuring device	1 688 130 095
or	1 688 130 130
Control-rod-travel measuring device	1 688 132 005
Prestroke measuring device	1 688 130 041
Dial indicator	1 687 233 015
Dial indicator	1 687 233 011

**B3**

Test equipment

Adjusting/testing PE(S)..A../PE(S)..P..





410/145

Composition of control-rod-travel measuring device  
1 688 130 130 for mounting on PE(S)..A.. pumps.

**B4**

Test equipment  
Adjusting/testing PE(S)..A../PE(S)..P..



#### 4.4.2 Test bench accessories for PE(S)..P.. pumps

##### For clamping:

Clamping support	1 688 120 032
Clamping support	1 688 030 095
Support block	1 688 030 033
Clamping support	1 688 030 047
Universal clamping bracket	1 688 010 010
Clamping bracket	1 688 010 040
Clamping bracket	1 688 010 042
Clamping bracket	1 688 010 044
Clamping flange	1 685 720 060
Clamping flange	1 685 720 159

##### For driving:

Coupling half	1 688 432 007
Coupling half, 25 mm cone diameter	1 416 430 022
Coupling half, 30 mm cone diameter	1 686 430 012
Coupling half, 35 mm cone diameter	1 686 430 017
Puller	KDEP 1557

##### For measuring:

Control-rod-travel measuring device	1 688 130 130
Control-rod-travel measuring device	with 1 687 000 053
Control-rod-travel measuring device	1 680 130 030
Bushing, short	1 680 362 019
Bushing, long	1 683 350 016
Coupling	1 688 040 017
Coupling	1 687 965 049
Coupling	1 688 040 018
Coupling	1 688 040 147
Prestroke measuring device	1 688 130 021
Prestroke measuring device	1 688 130 112



Test bench accessories for PE(S)..P.. pumps (continued)

Prestroke measuring device	1 685 130 085
Dial indicator	1 687 233 012
Dial indicator	1 687 233 015

For adjusting:

Box wrench	KDEP 2997
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**B6**

Test equipment

Adjusting/testing PE(S)..A../PE(S)..P..



## Tightening torques (continued)

### Item 1 - Delivery-valve holder

Model	Thread	Nm
PE(S)..P../..	M26 x 1.5	65 ... 80
PE(S)..P..A..	M26 x 1.5	80 ... 90
PE(S)..P..A..	M22 x 1.5	110 ... 120

Item 2 - Union nut max. 25 Nm

Item 3 - Flat-head screw 2 ... 3 Nm

Item 4 - Threaded bushing 20 ... 30 Nm

Item 5 - Bleeder screw 4 ... 5 Nm

Item 6 - Governor cover  
fastening screw

Model	Thread	Nm
RSV..., RQ..., RQV...,	M6	5 ... 7
	M8	11 ... 16
EP/MN..., MZ..	M5	4.5 ... 5.5

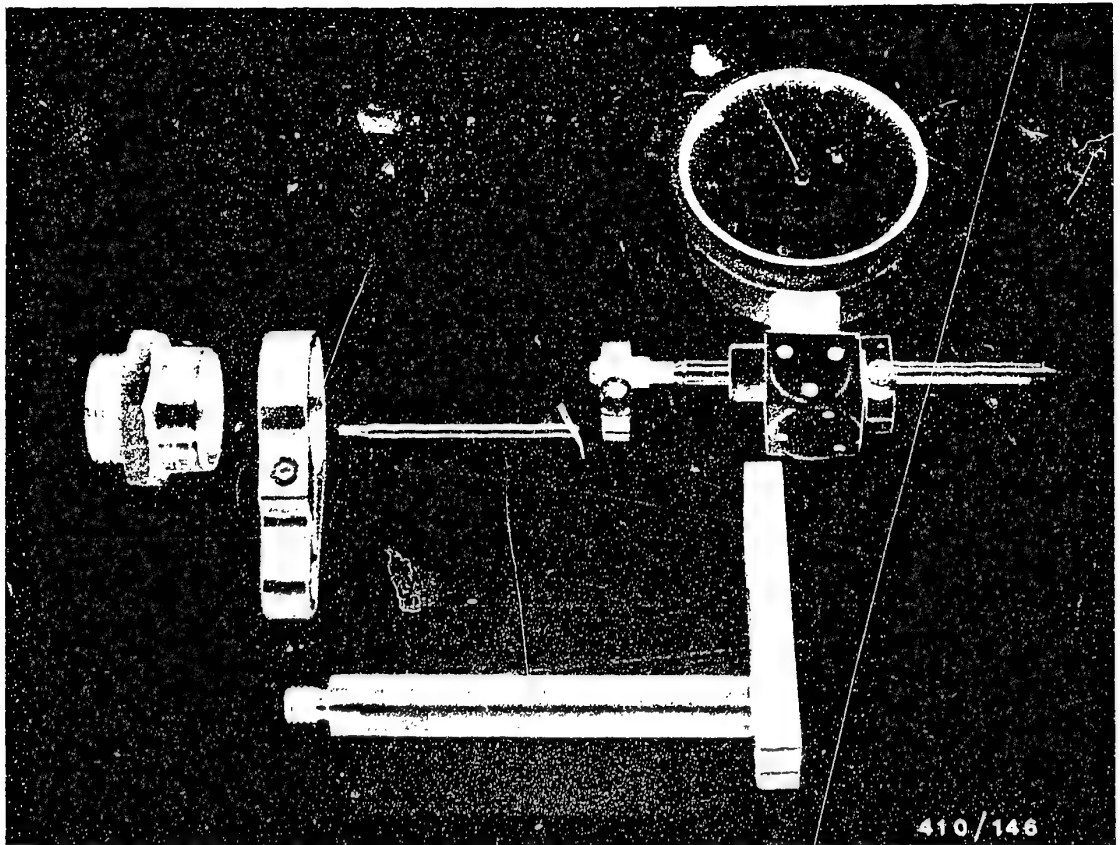
**A9**

Test specifications

Adjusting/testing PE(S)..A../PE..P..







Composition of control-rod-travel measuring device  
1 688 130 130 for mounting on PE(S)..P.. pumps

**B7**

Test equipment

Adjusting/testing PE(S)..A../PE(S)..P..



## Tightening torques (continued)

### Item 7 - Coupling

Cone dia.	Thread	Nm
20 mm	M14 x 1.5	65 ... 75
25 mm	M18 x 1.5	100 ... 110
30 mm	M20 x 1.5	150 ... 170
35 mm	M24 x 1.5	170 ... 200

Item 8 - Screw plug 8 ... 10 Nm

Item 9 - Screw plug 40 ... 60 Nm

Item 10- Closure cap 40 ... 60 Nm

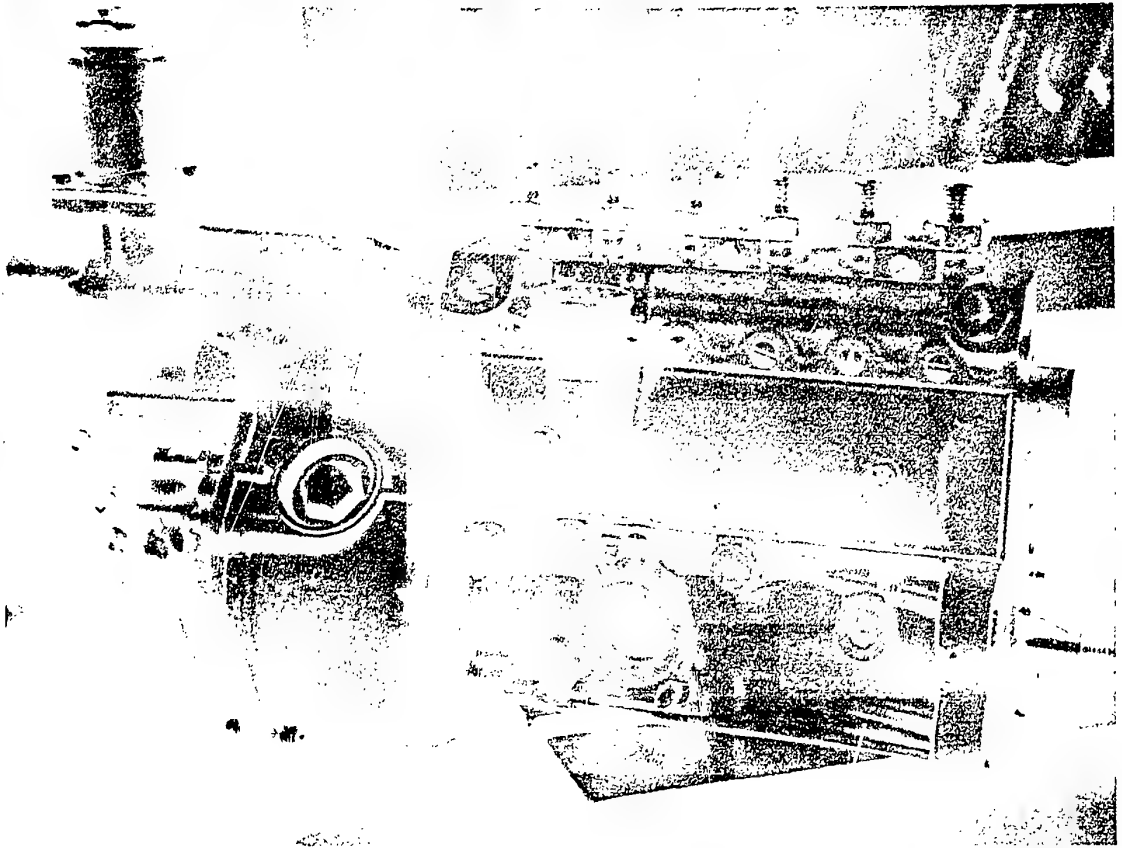
Item 11- Hexagon nut 40 ... 45 Nm

**A10**

Test specifications

Adjusting/testing PE(S)..A../PE..P..





## 5. Preparations for adjusting/testing PE(S)..A.. pumps

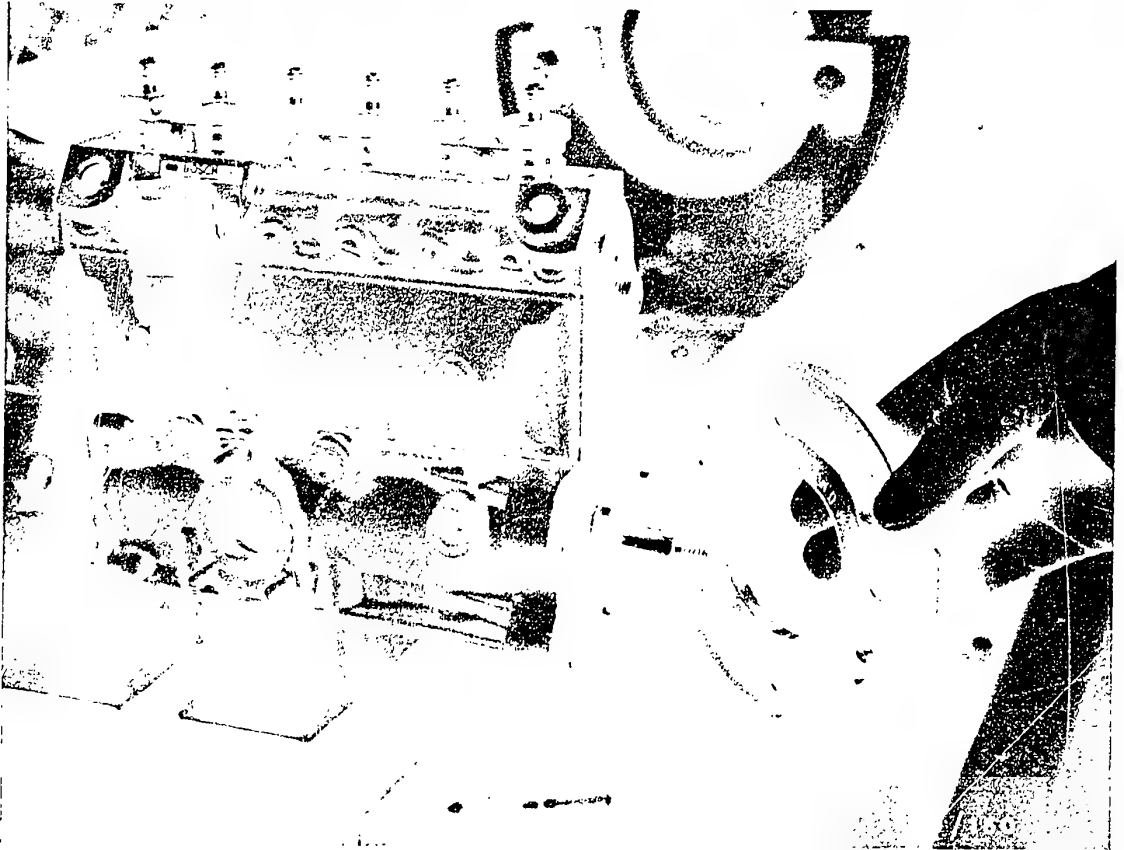
### 5.1 Preparing the pump

Remove supply pump, if applicable. Close the open bore in the injection-pump housing, e.g. with plug 1 900 508 024 (see picture). Remove timing device, if applicable. The special tools required for this can be found on tool board KDEP-T 2000.

**C1**

Preparations for adjusting / testing  
Adjusting/testing PE(S)..A.. pumps



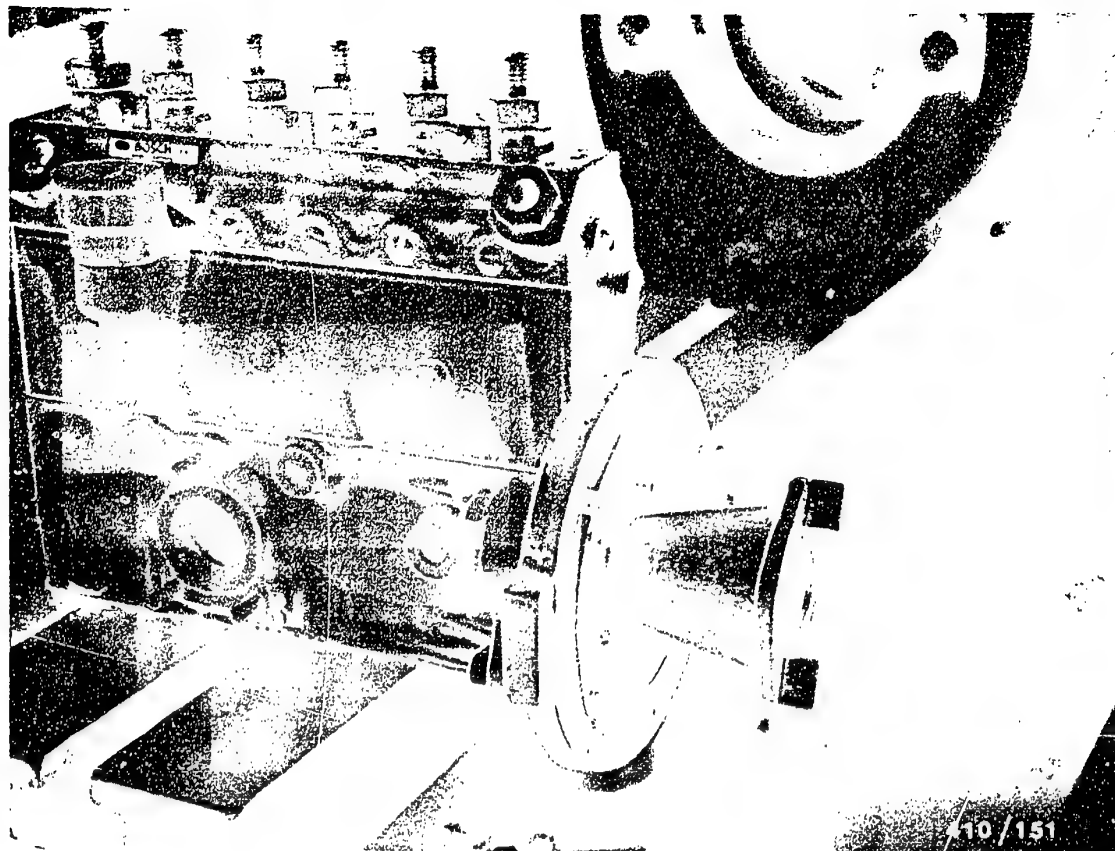


Mount the appropriate clamping flange on injection pumps that are mounted by means of an end flange (see picture).

**C2**

Preparations for adjusting / testing  
Adjusting/testing PE(S)..A.. pumps





Depending on the type of drive, mount the appropriate coupling part on the drive cone of the camshaft. A claw-type coupling half is mounted in place of a gear or timing device to suit the diameter of the cone:

For cone diameter 17 mm - 1 416 430 012

for cone diameter 20 mm - 1 416 430 017

for cone diameter 25 mm - 1 686 430 007

**C3**

Preparations for adjusting / testing  
Adjusting/testing PE(S)..A.. pumps



If the injection pump is driven on the engine with a multi-plate clutch, this remains mounted on the camshaft. In this case, remove the multi-plate clutch of the test bench and replace with a rigid drive part. If there is a flange on the camshaft for mounting a drive gear, mount combined puller and driving device KDEP 1557 on this flange.

**C4**

Preparations for adjusting / testing

Adjusting/testing PE(S)..A.. pumps





## 5.2 Preparing the injection-pump test bench

Injection pumps are to be tested only on the approved test bench for the respective injection pump with corresponding accessories.

The calibrating nozzle-and-holder assembly and calibrating fuel-injection tubing specified for setting the respective injection-pump assembly, as well as the suction-gallery pressure and the overflow valve are to be taken from the test specifications.

The calibrating oil must conform to the regulations on its usability in the test bench (in particular its viscosity).

**C5**

Preparing the injection-pump test bench  
Adjusting/testing PE(S)..A.. pumps



### 3. GENERAL NOTES ON TESTING OF INJECTION PUMPS

#### 3.1 Notes

The test instructions contain all important instructions and notes which must be followed when setting in-line pumps of sizes A and P.

The sequence of the described operations corresponds to the sequence in which the test specifications are given. The stated fuel deliveries are in each case the average of all plunger-and-barrel assemblies of a pump.

The stated difference between deliveries applies to the individual plunger-and-barrel assemblies of a pump.

Specified control-rod travels are set and measured with the corresponding control-rod-travel measuring device.

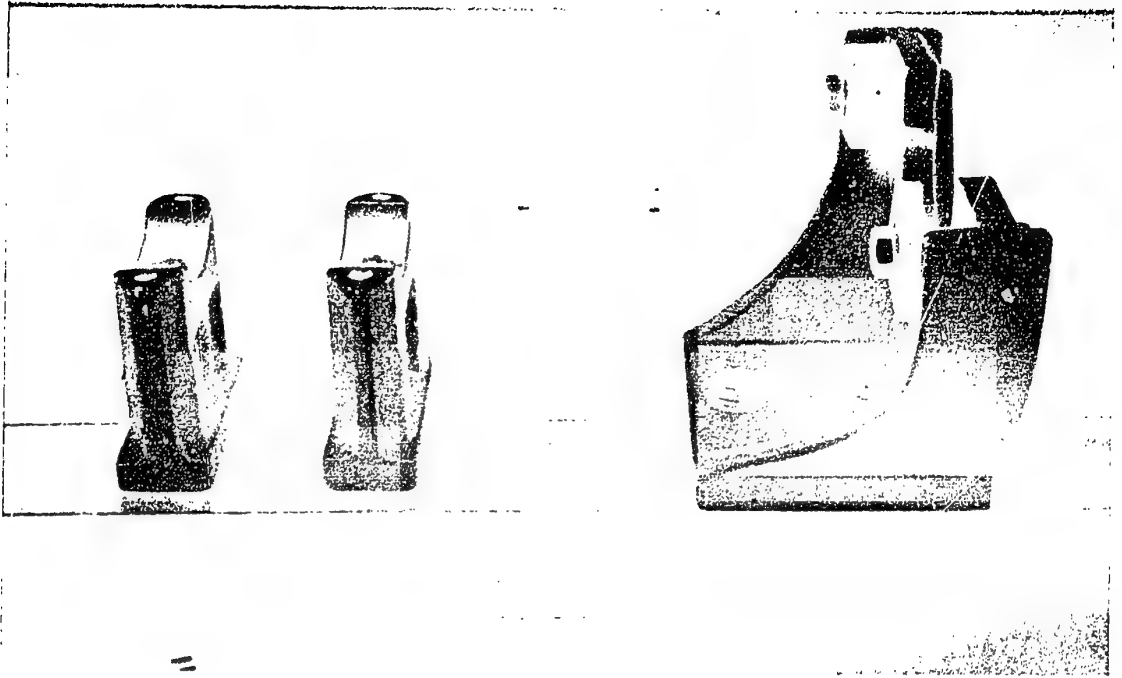
Checking values for fuel deliveries and difference between fuel deliveries are given in parentheses. These values apply only for checking a pump as received. Under no circumstances may they be used for resetting a pump.

**A11**

General notes

Adjusting/testing PE(S) .A../PE(S)..P





The clamping supports and/or clamping brackets required for mounting the injection pump should be placed on the test-bench clamping rail, but not screwed down at this stage.

**C6**

Preparing the injection-pump test bench  
Adjusting/testing PE(S)..A.. pumps



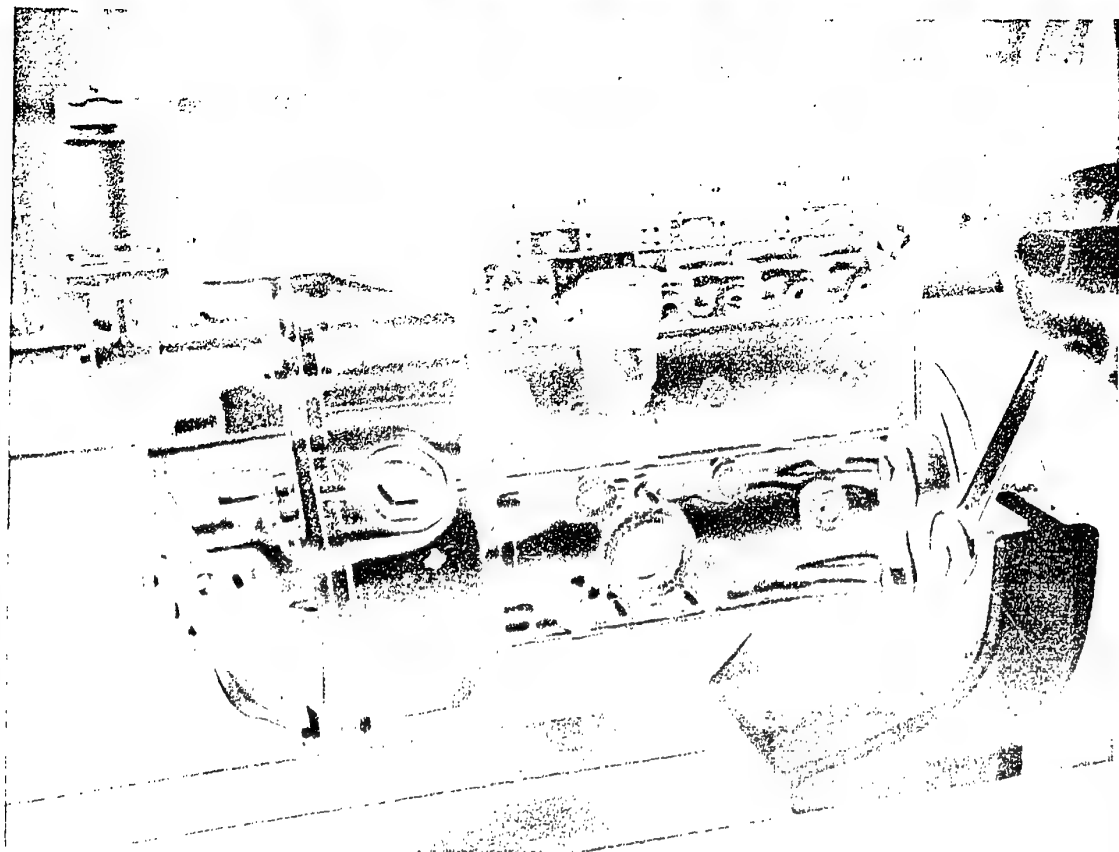
Pick out the appropriate connecting parts (inlet union and inlet-union screw) for the connection thread of the injection pump and for the inlet hose of the injection-pump test bench, and mount/hold ready.

If there is a multi-plate clutch on the drive cone of the injection-pump camshaft, remove the clutch on the test bench and replace with a rigid drive part which is mounted on the flywheel.

**C7**

Preparing the injection-pump test bench  
Adjusting/testing PE(S)..A.. pumps





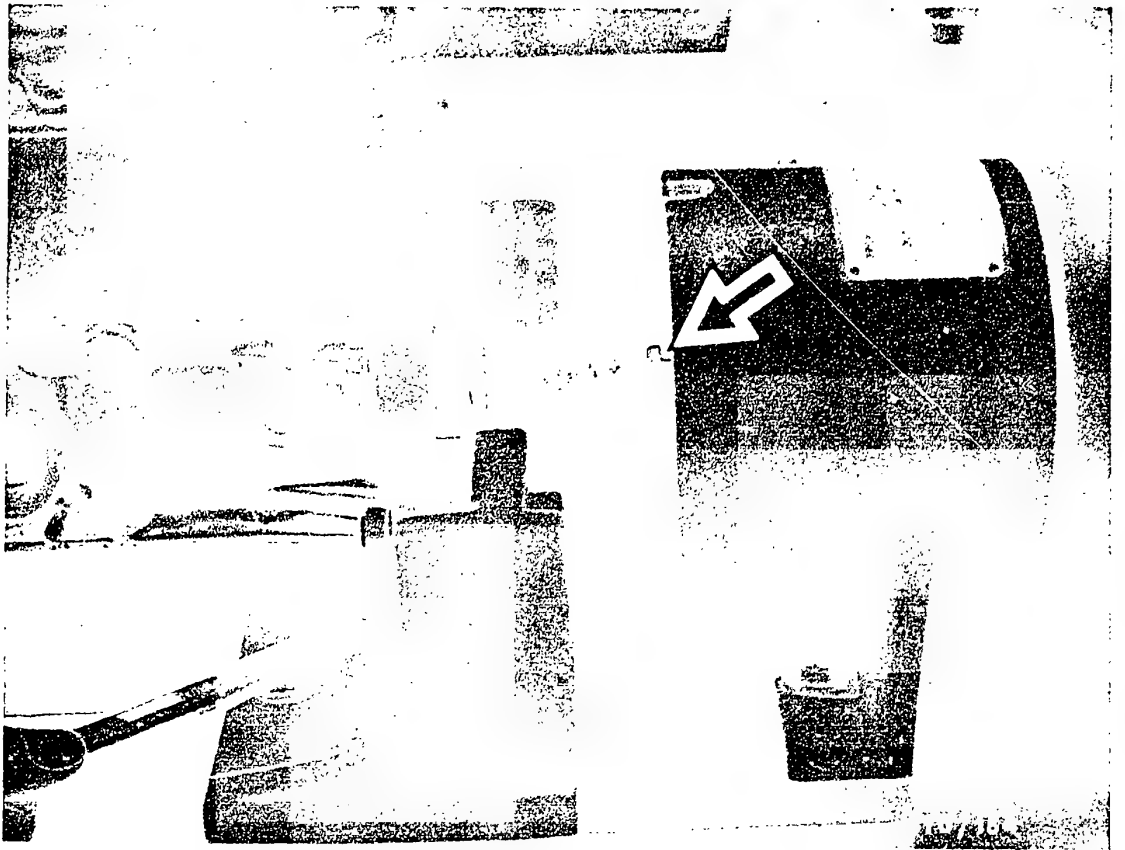
### 5.3 Mounting the injection-pump assembly

Place the injection-pump assembly on the prepared clamping parts and screw down.

**C8**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..A.. pumps





If the injection pump is driven by a claw-type coupling half, slide the mounted pump assembly toward the test bench coupling until the claws of the coupling half on the pump are between the clamping jaws of the test bench coupling. A gap of approx. 1 mm is essential between coupling half and clamping jaws (see picture, arrow). Tighten fastening screws of clamping supports/brackets. Firmly clamp coupling half in test bench coupling.

**C9**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..A.. pumps



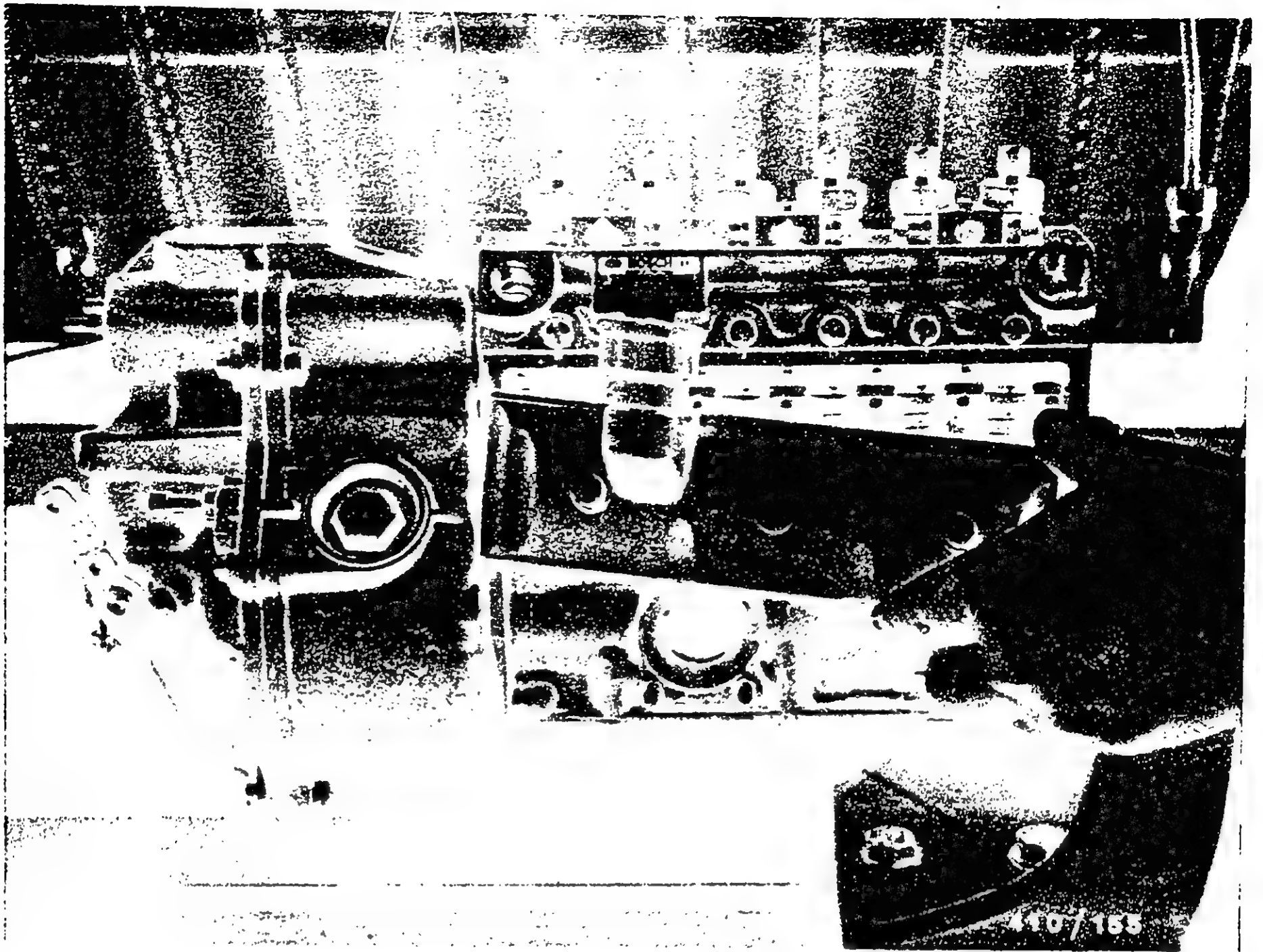


If the injection pump is driven by a multi-plate clutch, slide the mounted pump assembly until multi-plate clutch and rigid drive part on test bench touch. Screw multi-plate clutch onto rigid drive part and tighten to the specified tightening torque (depends on test bench). Secure clamping supports/brackets on clamping rail of injection-pump test bench.

**C 10**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..A.. pumps



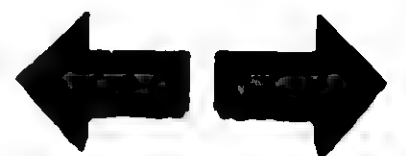


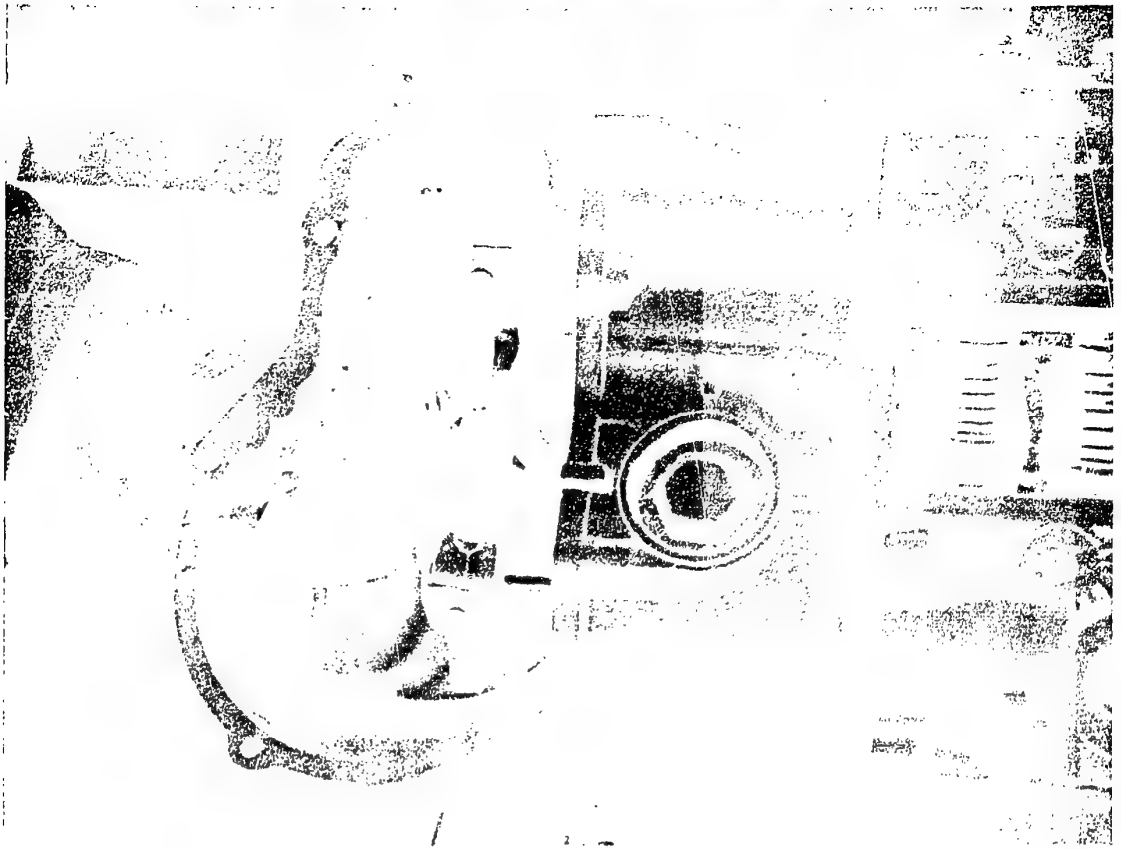
Remove spring-chamber closing cover.

Remove control-rod closure cap or drive-end control-rod stop or manifold-pressure compensator, if applicable.

**C11**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..A.. pumps





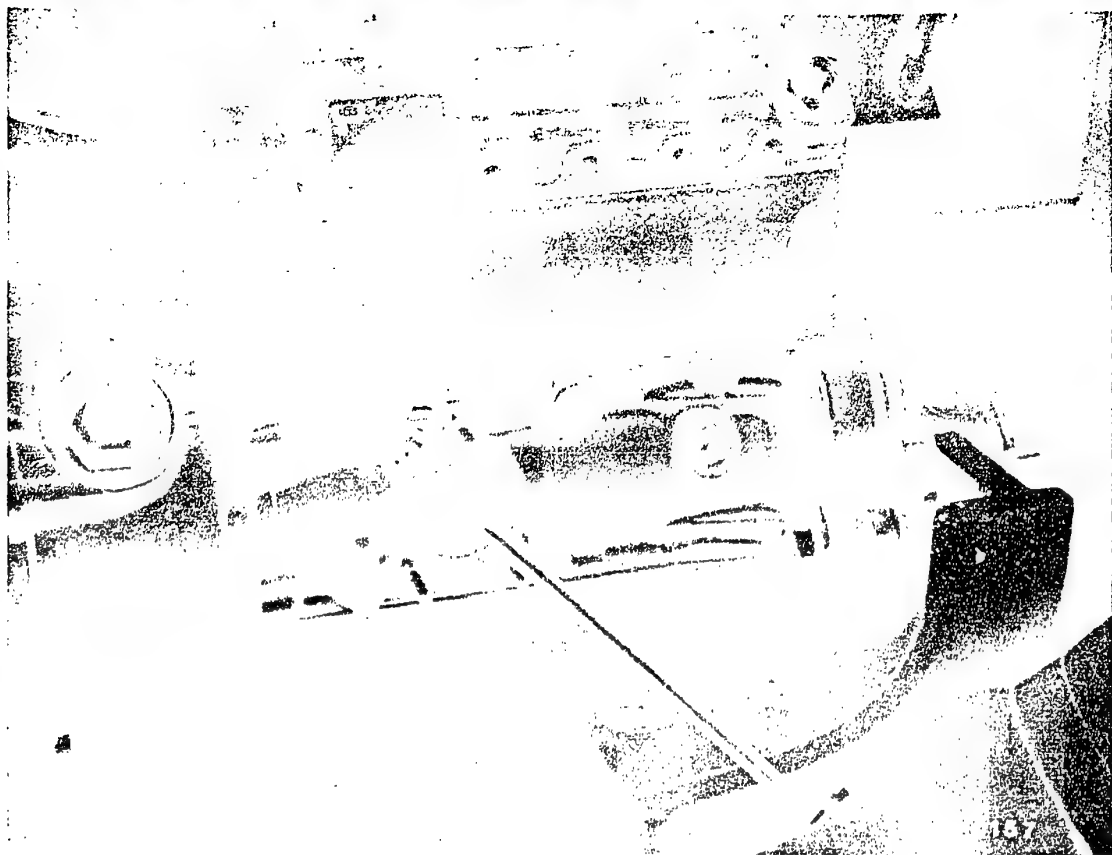
Remove governor cover (catch escaping oil), and replace by appropriate cover without additional part. This is necessary in order to prevent coming into contact with revolving governor components during adjusting.

••

**C12**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..A.. pumps





Pour the specified quantity of lubricating oil (engine oil) into the injection-pump assembly (see picture). Quantity in liters:

Pump with governor	Number of pump cylinders							
	2	3	4	5	6	8	10	12
RQ (V)	0.6	0.6	0.7	0.7	0.75	0.8	0.9	1.0
RSV	0.3	0.3	0.4	0.4	0.45	0.5	0.6	0.65
RZU	0.7	0.7	0.8	0.8	0.85	0.9	1.0	1.1
w/o governor	0.15	0.15	0.2	0.25	0.25	0.35	0.5	0.5

Test specifications for the appropriate pump-governor combination can be taken from microcard WP... .

**C13**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..A.. pumps



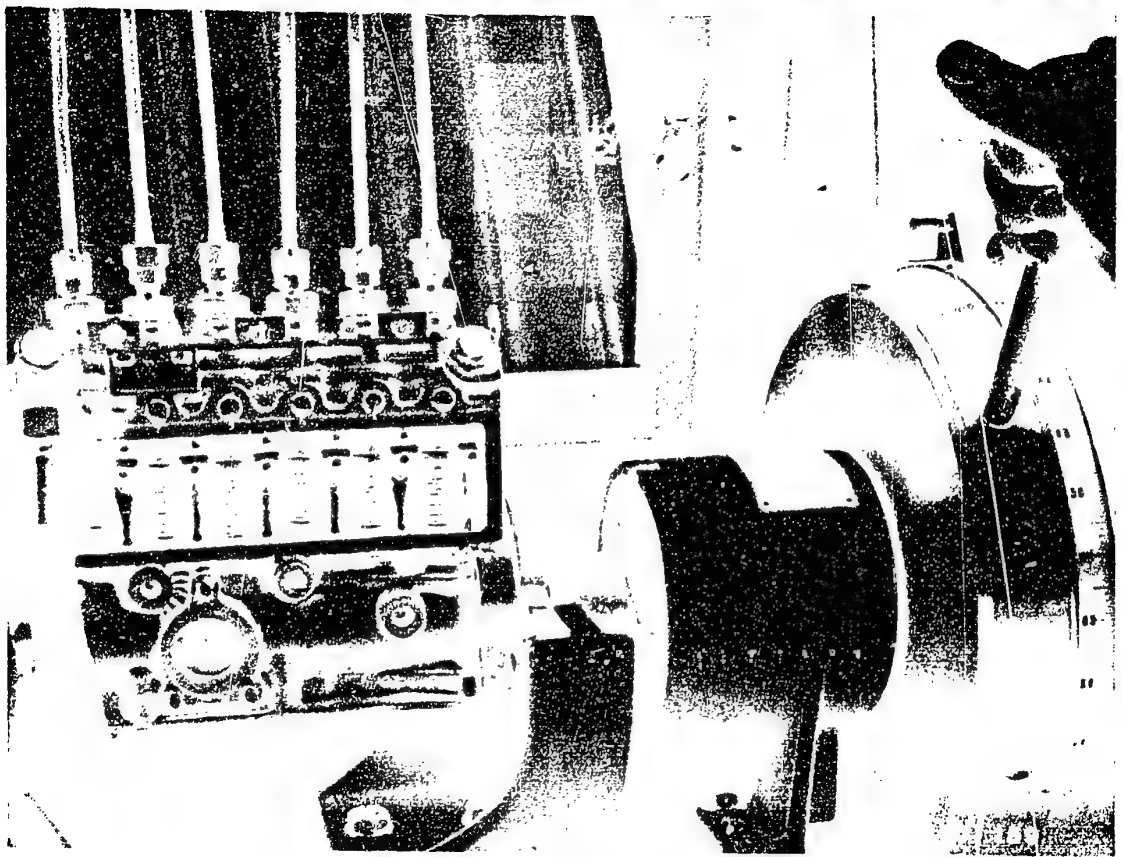


Provide injection pumps with inch thread on delivery-valve holder with specially provided connecting pieces 0 681 240 047 (see picture).

**C14**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..A.. pumps





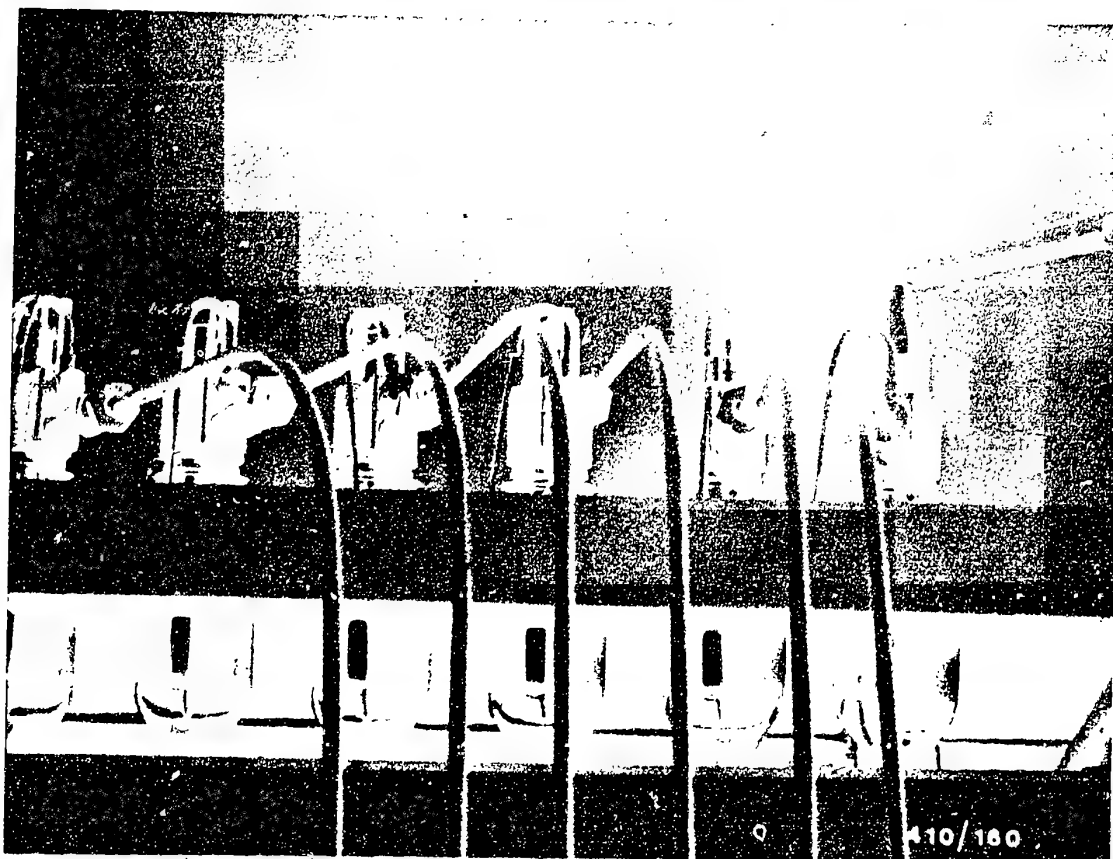
Secure calibrating fuel-injection tubing on delivery-valve holders of injection pump.

Using appropriate inlet-union screw, mount inlet hose of injection-pump test bench on fuel inlet of injection pump (identifiable by the Helicoil insert). Further threaded bores of the pump suction gallery, which serve to accommodate overflow valves, are dummy-sealed with screw plugs and copper seal ring. To ensure that the pump drive does not block, turn the camshaft over several times by turning the flywheel by hand (see picture).

**C 15**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..A.. pumps



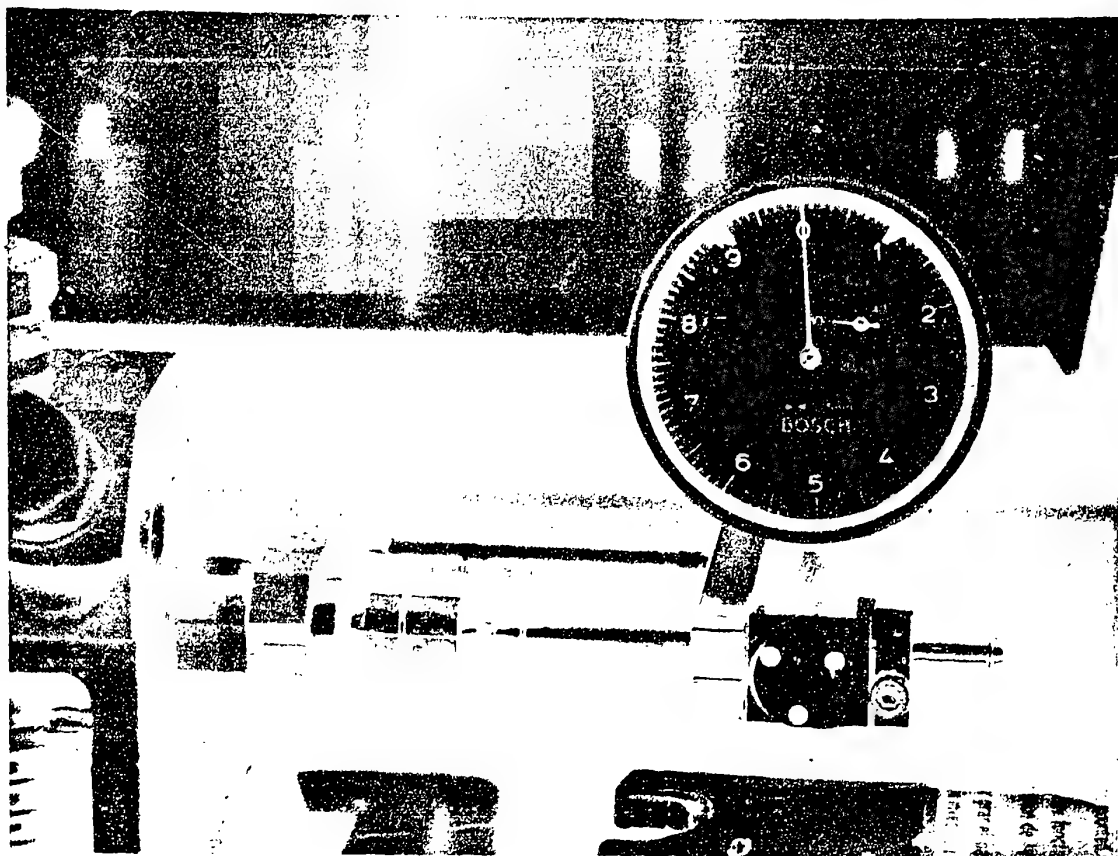


Open screw plugs on overflow pipes of all calibrating nozzle holders (see picture).  
Bring control rod into shutoff position. Switch on test bench and set high pressure of calibrating oil.  
Calibrating oil escapes from the overflow pipes of the calibrating nozzle holders. The initial foaming must slowly cease. As soon as the calibrating oil escapes free of foam, switch off the test bench and re-close the screw plugs of the overflow pipes.

**C 16**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..A.. pumps





#### 6. Measuring/adjusting the prestroke

Bring injection-pump test bench transmission into neutral. Mount control-rod-travel measuring device of the correct type on injection pump.

Slide injection-pump control rod in the direction of the governor as far as the mechanical stop.

In this position, set the dial indicator of the control-rod-travel measuring device to "0".

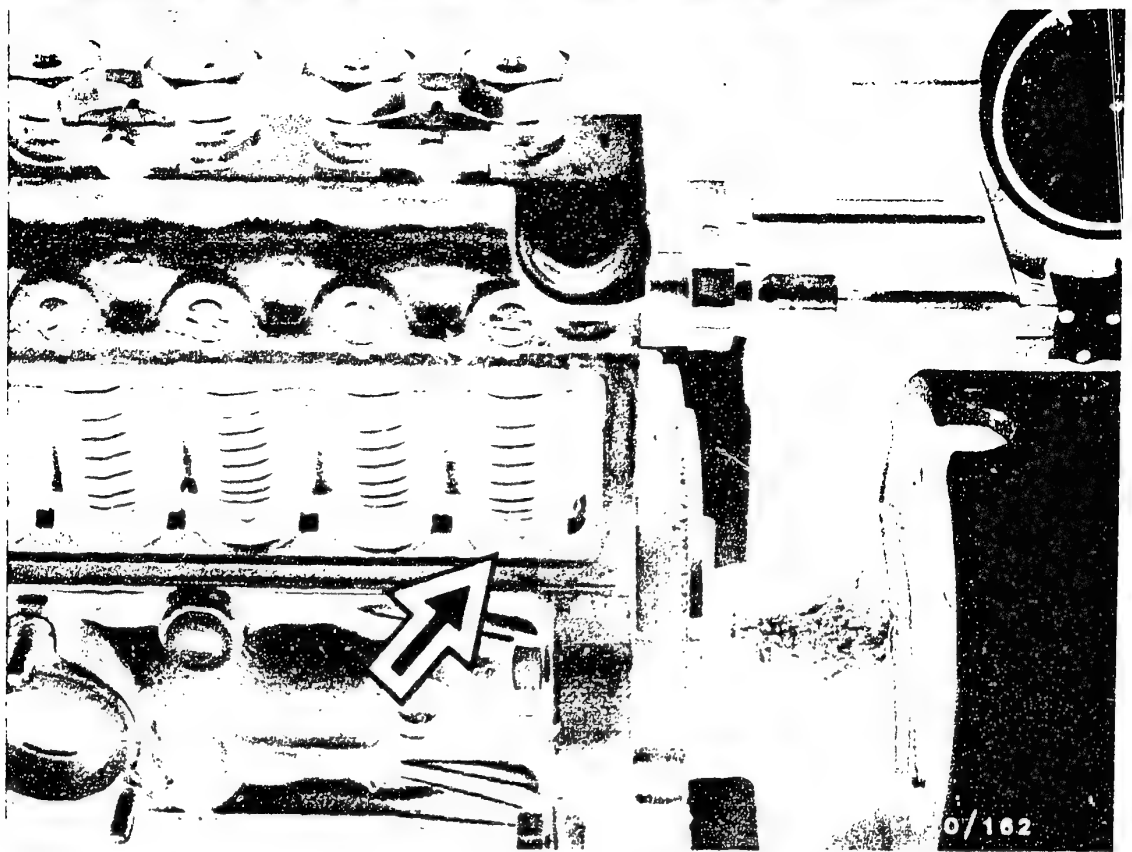
**C17**

Adjusting the prestroke

Adjusting/testing EP(S)..A.. pumps







Turn test bench flywheel by hand in the pump direction of rotation until the roller tappet nearest the pump drive is at BDC (see picture, arrow).  
Set dial indicator to "0".

Note:

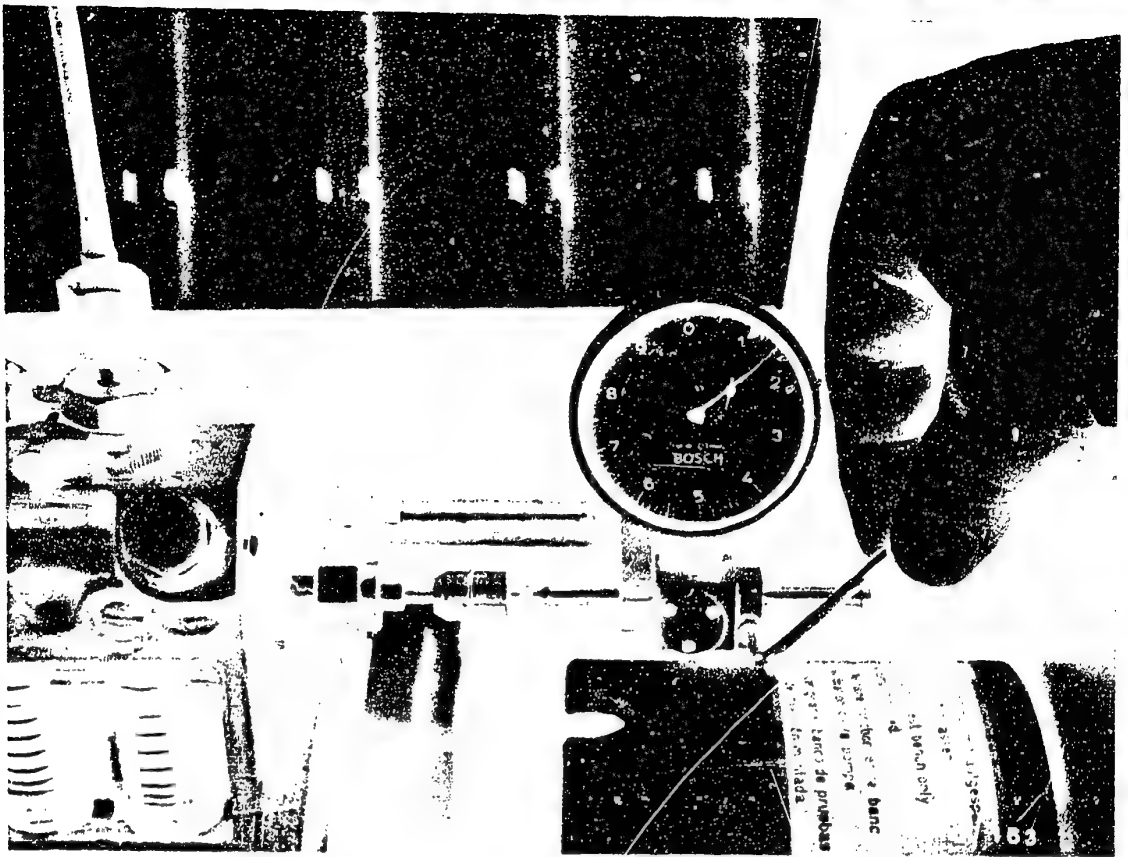
If the prestroke adjustment is made on a different roller tappet, this is to be taken from the test specifications and this roller tappet should be brought to BDC.

**C18**

Adjusting the prestroke

Adjusting/testing PE(S)..A.. pumps





Slide control rod in the "start" direction until the dial indicator of the control-rod-travel measuring device indicates the control-rod travel specified in the test-specification sheet for adjusting the prestroke. In this position, fix control rod on control-rod-travel measuring device with clamping device (see picture).

Note:

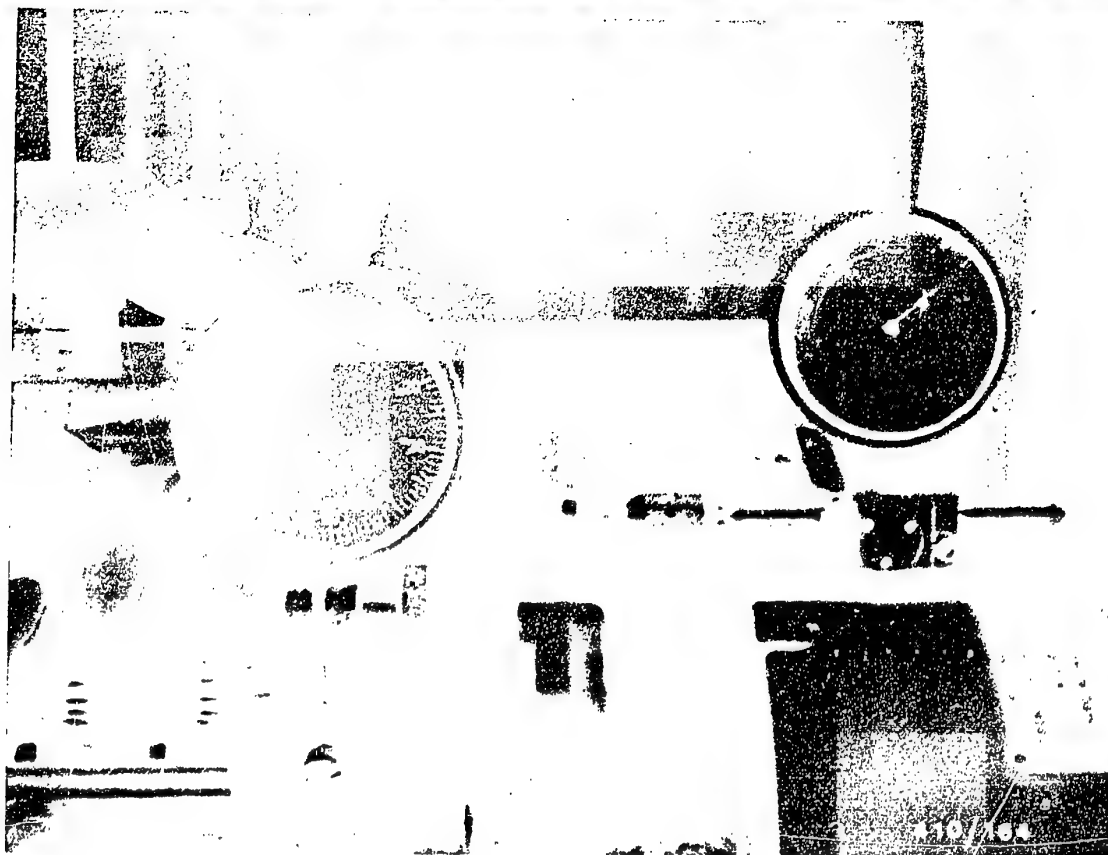
If, in older test specifications, no control-rod travel is specified for measuring the prestroke, set the control-rod travel which is inside a frame and which is specified for the basic setting of the pump. If the pump has plunger-and-barrel assemblies with upper helix, the prestroke is not set until after the basic setting of the pump.

**C19**

Adjusting the prestroke

Adjusting/Testing PE(S)..A.. pumps





Mount prestroke measuring device 1 688 130 041 on injection pump. Insert dial indicator 1 687 233 011 into device and, with the roller tappet at BDC, set to "0".

**C20**

Adjusting the prestroke

Adjusting/testing PE(S)..A.. pumps



Switch on the injection-pump test bench and, on the test bench, set the high pressure required for adjusting the prestroke. Calibrating oil begins to flow from the open overflow pipe of the calibrating nozzle holder.

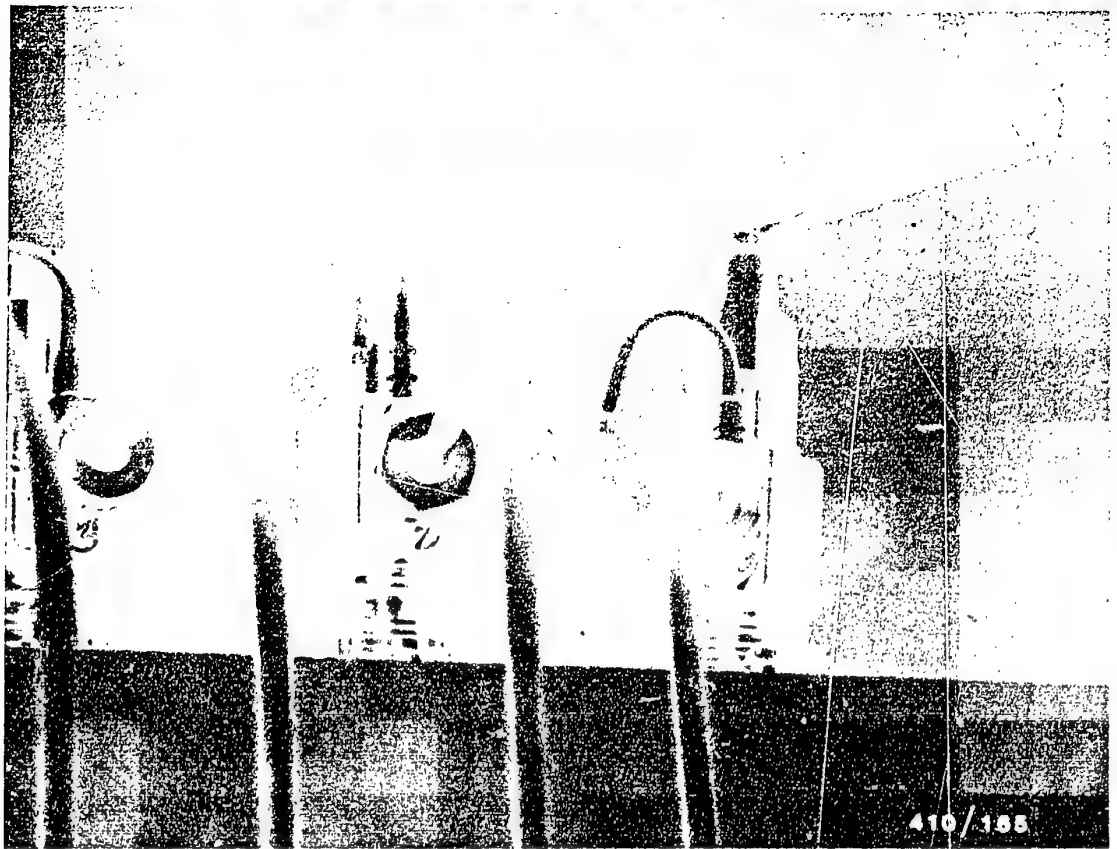
Turn flywheel of injection-pump test bench by hand in pump direction of rotation.

Note:

Direction of rotation is contained in the type designation of the injection pump. Example: PE(S)6A90D410RS  
2293

The underlined letter indicates the direction of rotation - looking onto the drive of the pump (R/L = right/left = clockwise/counter-clockwise).





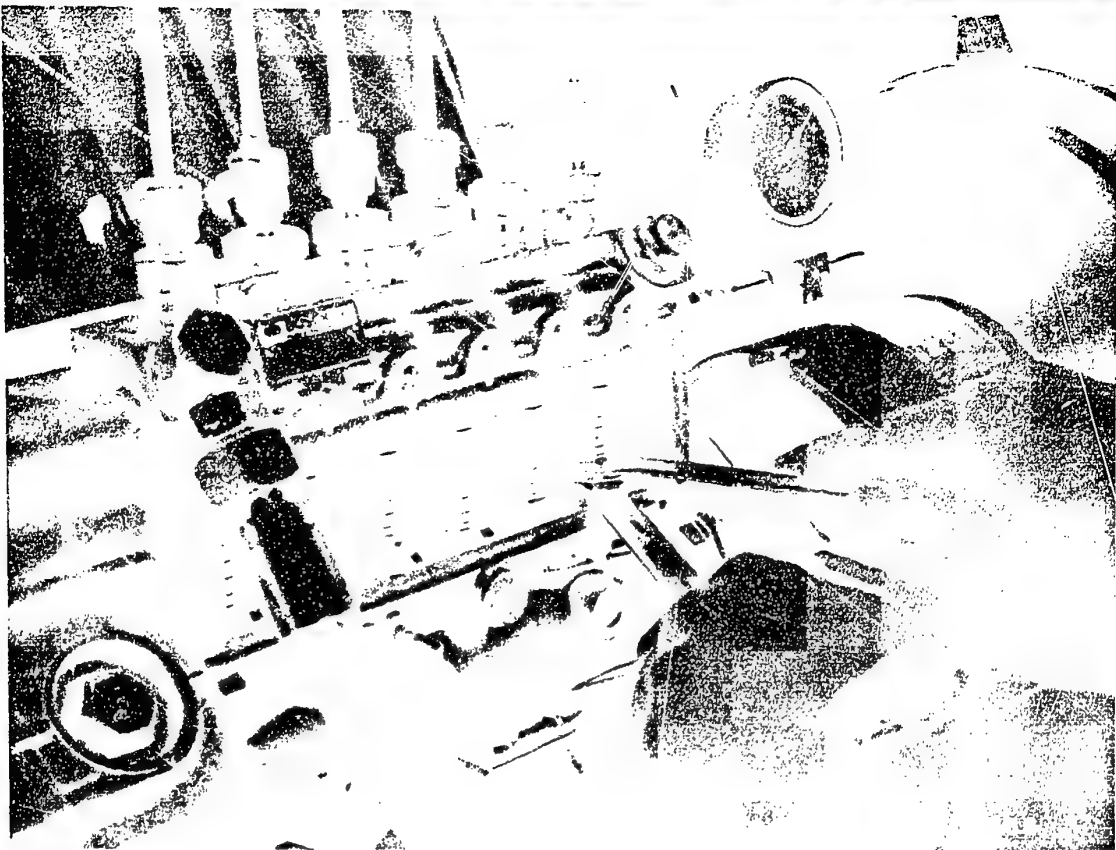
When the flow of calibrating oil from the overflow pipe of the calibrating nozzle holder changes into a chain of drops (see picture), take the reading from the dial indicator of the prestroke measuring device. The reading is the prestroke.

**C22**

Adjusting the prestroke

Adjusting/testing PE(S)..A.. pumps





If the reading does not agree with the value given in the test specifications, it is necessary to adjust the prestroke:

Remove the prestroke measuring device. Switch off the test bench. Turn the test bench flywheel by hand in the specified direction of rotation until the roller tappet of the cylinder under test is at TDC.

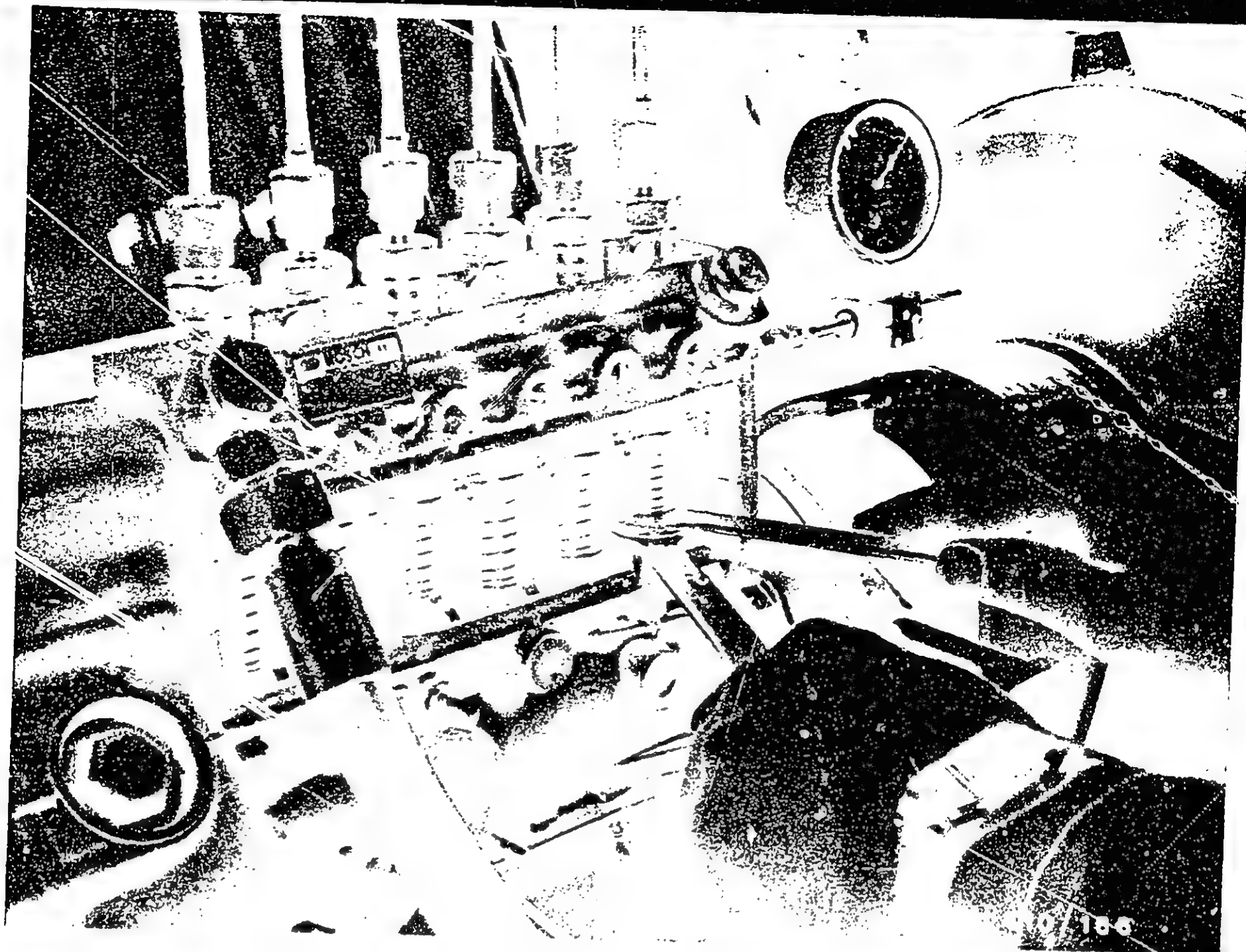
Using an open-end wrench KDEP 2922, loosen lock nut of tappet screw and turn slightly upward.

**C23**

Adjusting the prestroke

Adjusting/testing PE(S)..A.. pumps



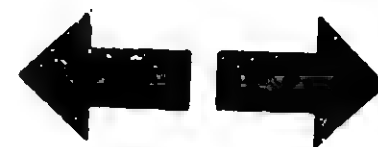


If the prestroke reading is greater than the value given in the test specifications, turn tappet screw upward out of KDEP 2922 with an open-end wrench. The pitch of the thread of the tappet screw is 1 mm, i.e. if the prestroke is 0.5 mm too great, the screw must be turned upward by half a turn. If the prestroke is too small, turn the tappet screw downward.

**C24**

Adjusting the prestroke

Adjusting/testing PE(S)..A.. pumps



### 3.2 Calibrating oil

The calibrating oil must conform to ISO standard 4113. It must not be mixed or contaminated with lubricating oil or diesel fuel from the fuel-injection pump since this will influence the measured values.

The admixture of other constituents might otherwise lead to the formation of an ignitable gas-air mixture and possibly to an explosion.

The specified calibrating oil temperature for in-line pumps is 38 - 42° C in the inlet.

If using the continuous injected-quantity measuring system (KMM), the ambient temperature must not exceed +40°C.

#### Testing the viscosity:

Test equipment: ● Collector vessel with lid  
● Thermometer with protective tube and holder  
● Viscosity test beaker  
● Stopwatch (not included)

} KDEP 1500

#### Inspection intervals (depending on frequency of use of test bench)

- 1 x per week (according to ISO standard 4008/III).
- no later than after testing 20 injection pumps or after approx. 35 hours of operation.
- after no later than 6 months if, in the meantime, no injection pumps or less than 20 have been tested.

#### Preparations

Fill collector vessel approx. 3/4 full with filtered calibrating oil from the test bench inlet line. Ensure utmost cleanliness. Even minute particles of dirt (e.g. fluff in the collector vessel) will falsify the measurements.





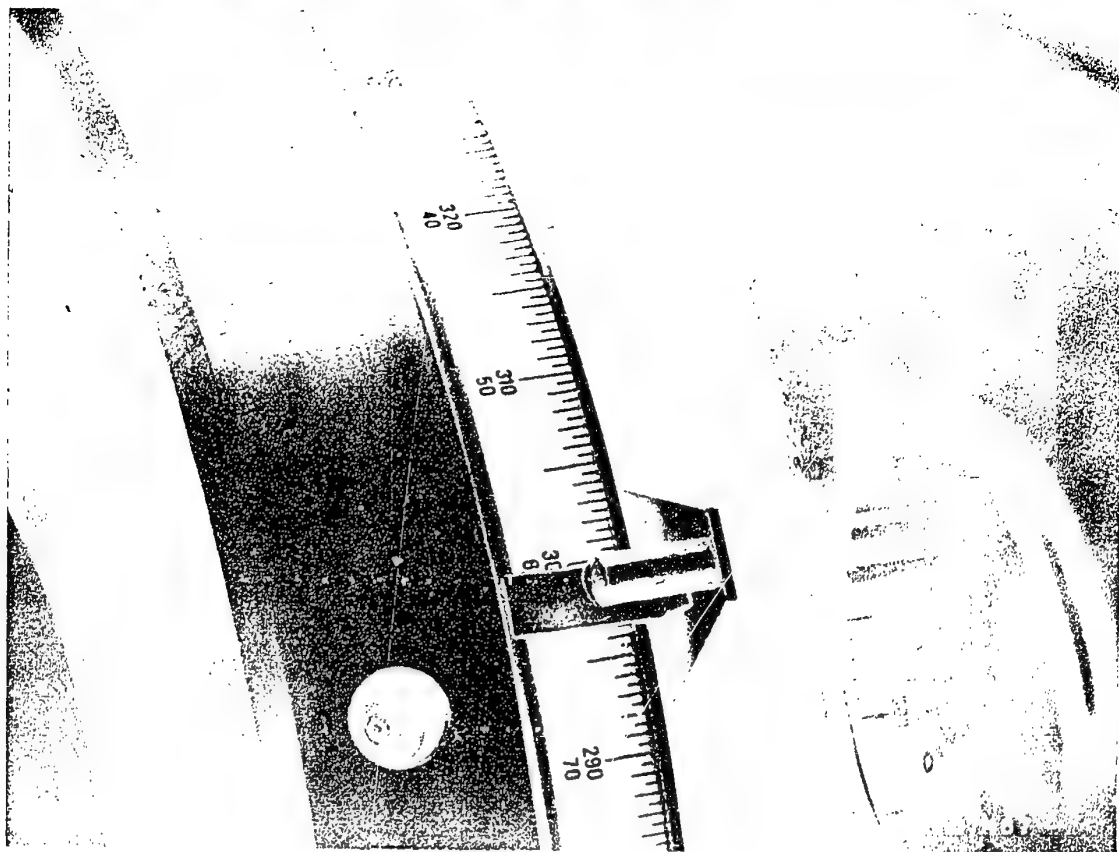
Lock the tappet screw (tappet screw must not rotate).  
Continue to turn the test bench flywheel in the specified direction of rotation until the set roller tappet is again at BDC.  
Re-mount prestroke measuring device on injection pump.  
Set dial indicator to "0".

**D1**

Adjusting the prestroke

Adjusting/testing PE(S)..A.. pumps





Switch on the injection-pump test bench and measure the prestroke by turning the flywheel of the pump test bench by hand as specified.

If the reading still does not agree with the value given in the test-specification sheet, repeat the prestroke adjustment. When the prestroke has been correctly adjusted, first of all hold the flywheel in this position and set the pointer on the pump test bench flywheel to an "even" number (divisible by 10). This makes it easier subsequently to measure the start-of-delivery spacing. Remove the prestroke measuring device.

**D2**

Adjusting the prestroke

Adjusting/testing PE(S)..A.. pumps



## 6.1 Adjusting the start-of-delivery spacing

Close the overflow pipe of the calibrating nozzle holder of the barrel under test. Open the overflow pipe of the next barrel in the cam sequence.

Turn camshaft in the specified direction of rotation until the flow of fuel changes into a chain of drops. Read off the number of degrees on the pointer on the flywheel of the test bench and subtract from this figure the value to which the pointer was set previously with the preceding barrel in the start-of-delivery position.

Example:

Cam sequence 1-5-3-6-2-4

Start-of-delivery spacing: 0-60-120-180-240-300-360°  
cam angle

Start of delivery for barrel 1 yielded pointer position  
130° (1)

Start of delivery for barrel 5 yielded pointer position  
191° (2)

Value (1) subtracted from value (2) = 61° cam angle.

This means that the start-of-delivery spacing between barrel 1 and barrel 5 is 61° cam angle.

This value is noted down.



Then do the same with the other barrels, and enter the values in the test record.

The start-of-delivery spacing of the individual barrels is also adjusted by turning the tappet screw.

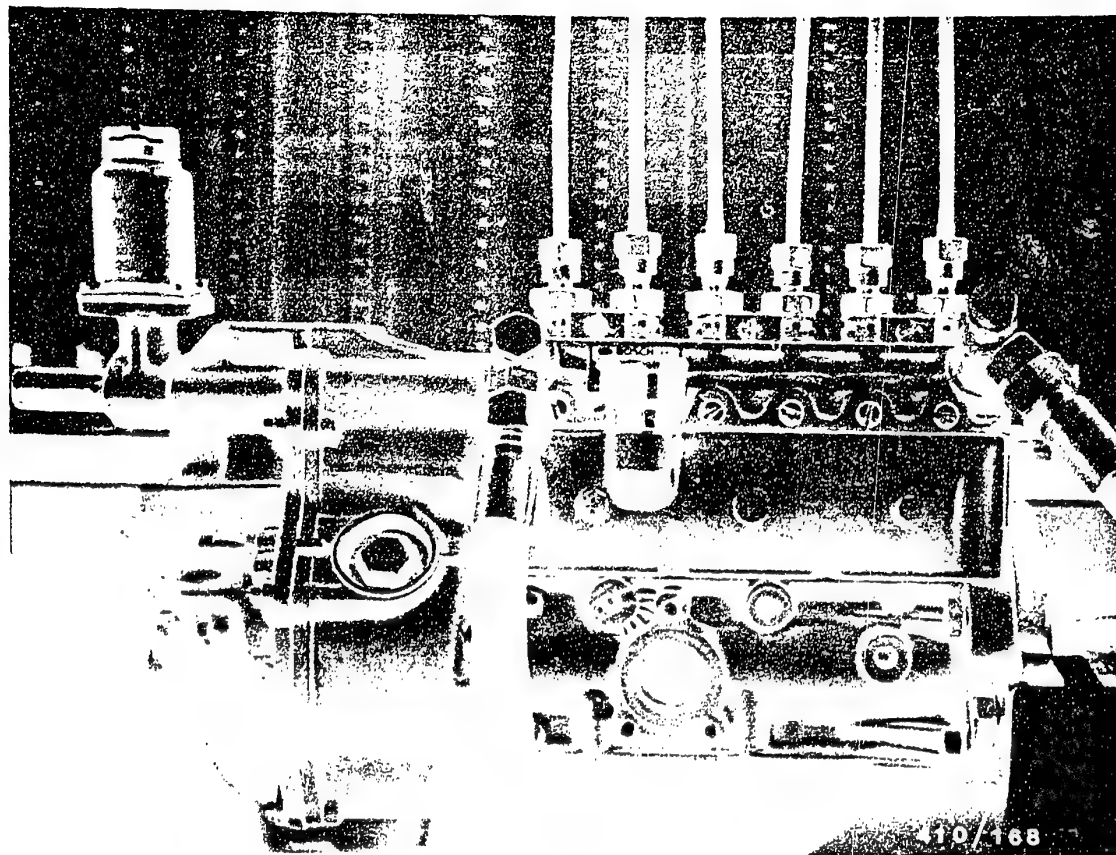
If the cam spacing is too great, turn the tappet screw of the barrel in question upward. If the cam spacing is too small, turn the tappet screw downward.

After completing the adjustment of prestroke and start-of-delivery spacing, loosen again the locking screw on the control-rod-travel measuring device.

**D4**

Adjusting the start-of-delivery spacing  
Adjusting/testing PE(S)..A.. pumps





## 7. Checking and adjusting the basic setting

The overflow pipes of all calibrating nozzle holders are closed.

If scavenging of the suction gallery is specified for adjusting the injection pump, the calibrating oil return hose must be connected to the specified overflow valve (as per test specifications) at the threaded bore provided for this purpose.

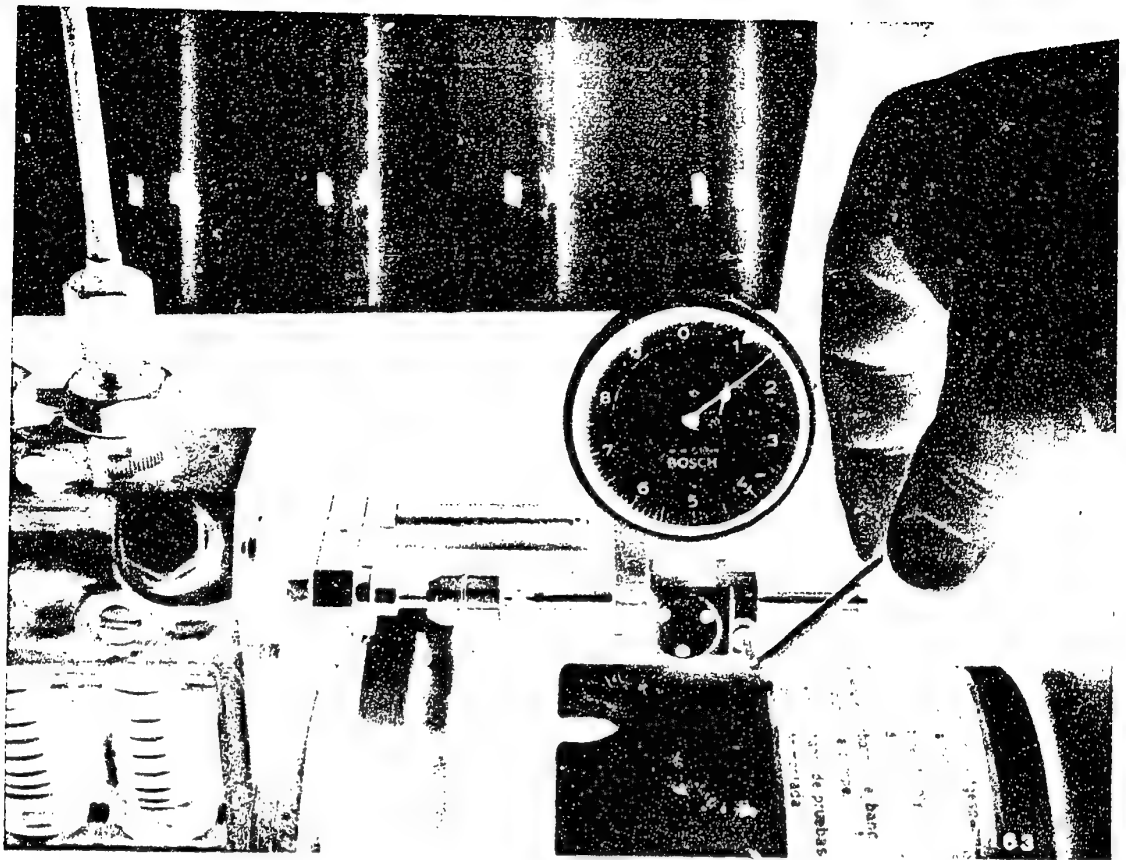
Switch on injection-pump test bench and set the inlet pressure specified in the test-specification sheet. Heat up the calibrating oil until the inlet temperature specified in the test specifications is obtained.

**D5**

Basic setting

Adjusting/testing PE(S)..A.. pumps





Slide the injection-pump control rod out of the shutoff position toward "max." until the control-rod travel specified in the test-specification sheet is obtained. In this position, fix the control rod on the control-rod-travel measuring device with clamping device.

**D6**

Basic setting

Adjusting/testing PE(S)..A.. pumps



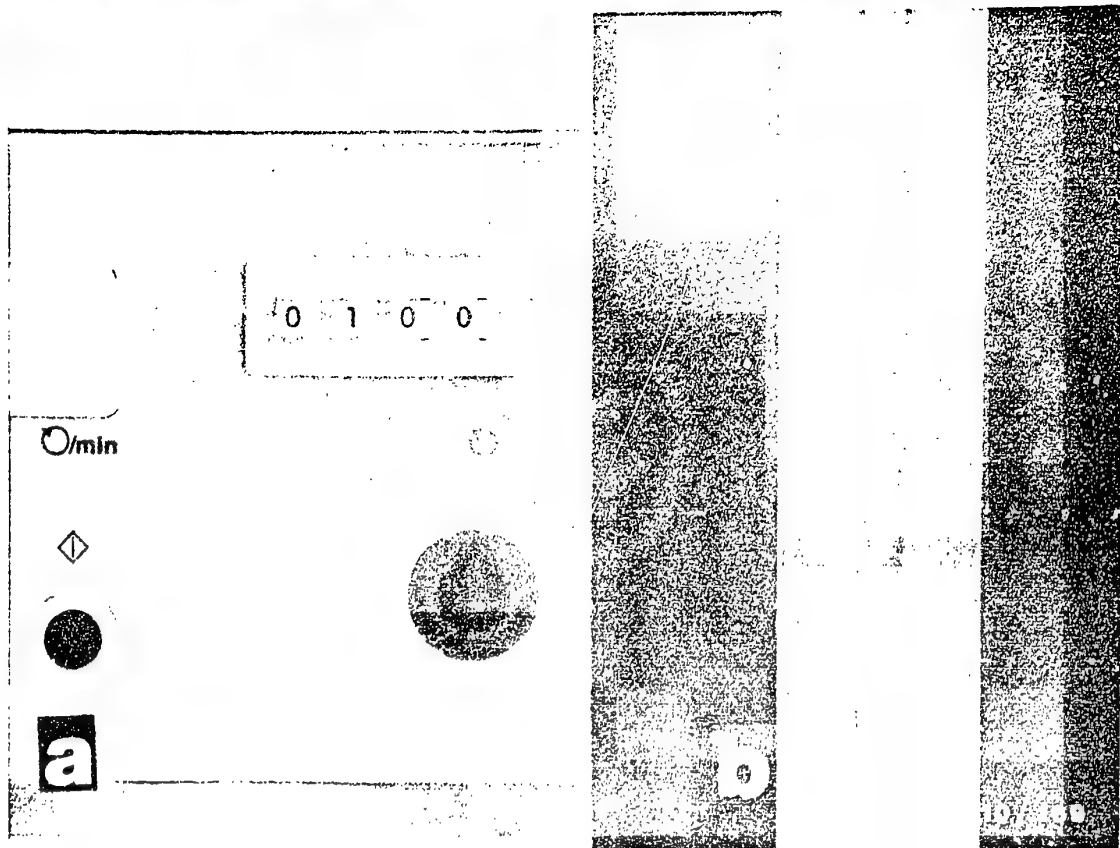
Drive injection pump at specified speed.  
Set stroke counter to "100" and switch on.  
The quantity of calibrating oil which is caught in the measuring glasses of the test bench is used in the first measurement only for wetting the measuring glasses. The measuring glasses are emptied again. The discharge time is 29 to 31 seconds. If the pause after discharging up to the next measurement is longer than 10 minutes, wet measuring glasses again.

**D7**

Basic setting

Adjusting/testing PE(S)..A..pumps





Leave stroke counter at "100" and trigger.  
After the stroke counter has completed the measurement, read off the quantity of calibrating oil in each measuring glass and note down. A blue stripe, which is opposite the numbering on the measuring glass, is used for an accurate reading (see picture, arrow).  
If the measuring glass is wetted, light refraction at the surface of the liquid results in two superimposed points. Always read off the fuel delivery at the scale mark indicated by the two points.

**D8**

Basic setting

Adjusting/testing PE(S)..A.. pumps





The fuel delivery given in the test specifications is the average of all individual deliveries measured. Also establish whether the allowable dispersion given in the test specifications is exceeded. The dispersion indicates the difference between the largest and the smallest fuel deliveries.

Example:

Specified delivery = 12.1 - 12.3 cm<sup>3</sup>/100 strokes

Allowable dispersion = 0.3 cm<sup>3</sup>/100 strokes

Cylinder No.	1	2	3	4	5	6	Average
Delivery	12.4	12.2	12.5	12.3	12.5	12.4	12.38

Dispersion: 12.5 - 12.2 = 0.3 cm<sup>3</sup>/100 strokes

This setting is not allowable; the average of all cylinders is not between 12.1 and 12.3 cm<sup>3</sup>/100 strokes

Cylinder No.	1	2	3	4	5	6	Average
Delivery	12.4	12.2	12.0	12.3	12.1	12.4	12.23

Dispersion: 12.4 - 12.0 = 0.4 cm<sup>3</sup>/100 strokes

This setting is not allowable; the dispersion is greater than 0.3 cm<sup>3</sup>/100 strokes.

**D9**

Basic setting

Adjusting/testing PE(S)..A.. pumps



Cylinder No.	1	2	3	4	5	6	Average
Delivery	12.4	12.2	12.2	12.3	12.1	12.4	12.26

Dispersion:  $12.4 - 12.1 = 0.3 \text{ cm}^3/100 \text{ strokes}$

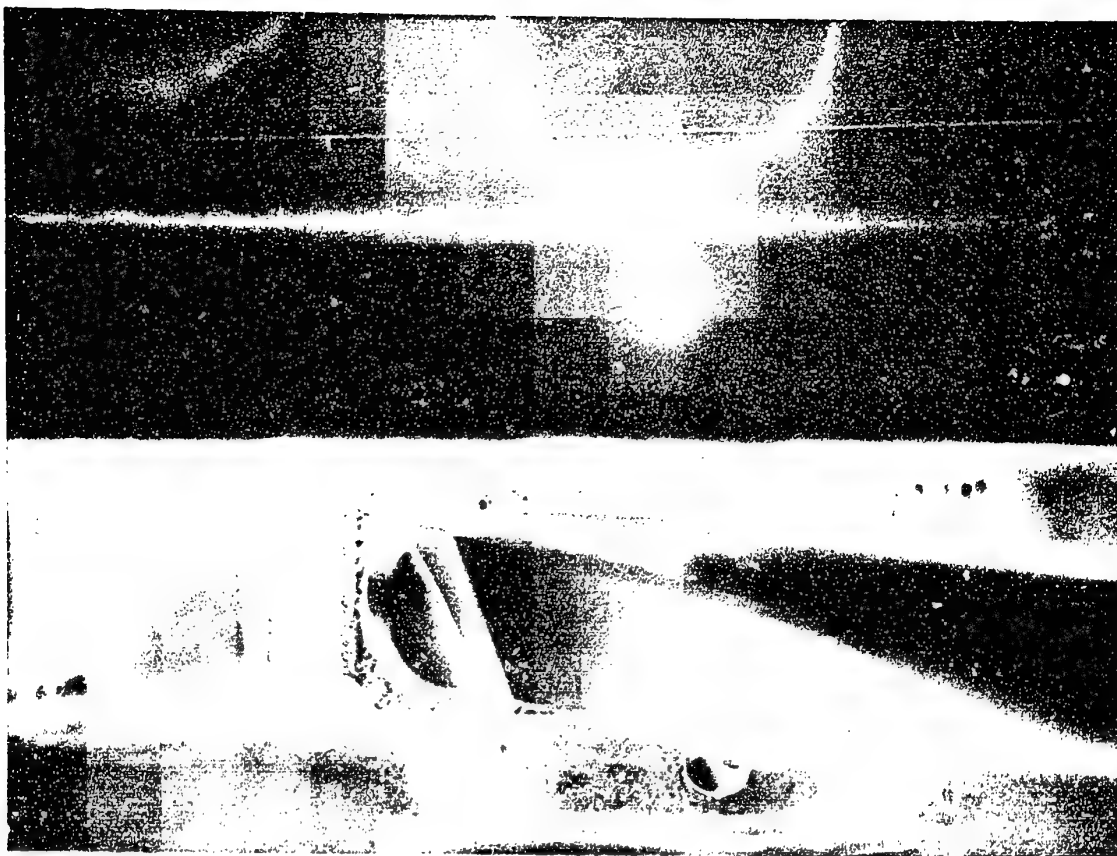
This setting is allowable.

**D 10**

Basic setting

Adjusting/testing PE(S)..A.. pumps





If, due to unallowable values, it is necessary to improve the setting of the injection pump, proceed as follows:

Switch off the pump test bench. Unclamp the control rod from the control-rod-travel measuring device. Slide the control rod until the slot of the clamping screws in the control pinions is accessible (see picture).

Using a screwdriver, loosen the clamping screws of the barrels which have to be corrected, and turn the control sleeve using a suitable tool. The fuel delivery is increased by turning the control sleeves toward the governor.

**D11**

Basic setting

Adjusting/testing PE(S)..A.. pumps



After correcting the setting, re-tighten the clamping screws of the control pinions. Return the control rod to the specified position and fix.

Then once again measure one hundred strokes at the specified speed. If the specified values are still not obtained, make correction again.

After the basic setting is completed, perform the measurement given beneath it in the test specifications at the specified speed and at the corresponding control-rod travel.

If the delivery specified in the test-specification sheet is not obtained, this may be due to the following causes:

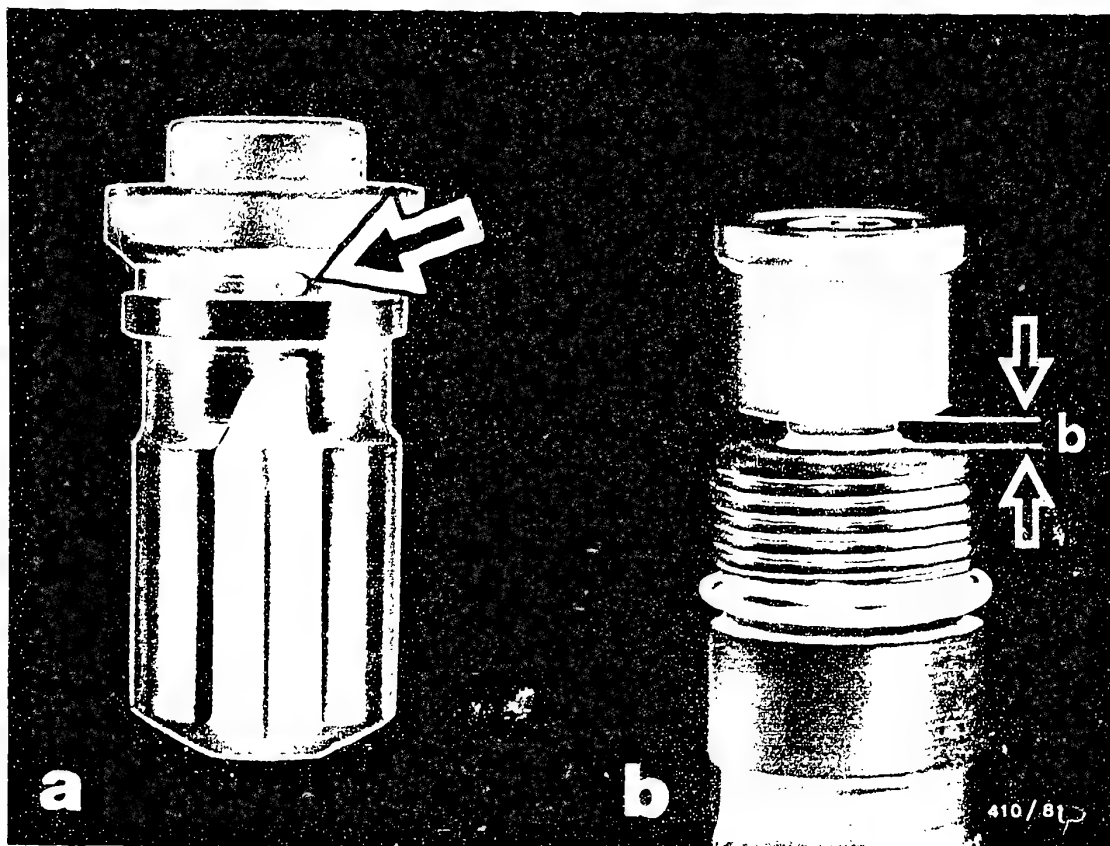
- + Use of incorrect or unserviceable plunger-and-barrel assemblies
- + Use of incorrect or unserviceable delivery valves
- + Incorrect delivery valve springs and/or filler pieces in delivery-valve holder
- + Incorrect or unserviceable delivery-valve holders (unserviceable as a result of cavitation)
- + Incorrect setting of the delivery-valve spring pre-load, particularly in the case of injection pumps with torque-control delivery valves.

**D 12**

Basic setting

Adjusting/testing PE(S)..A.. pumps





Torque-control delivery valves can be identified by the small bore (see picture a, arrow) between sealing cone and retraction collar of the valve cone. The adjusting dimension "b" (see picture b) for the spring preload of the delivery-valve spring is given in the test specifications under section C "Remarks".

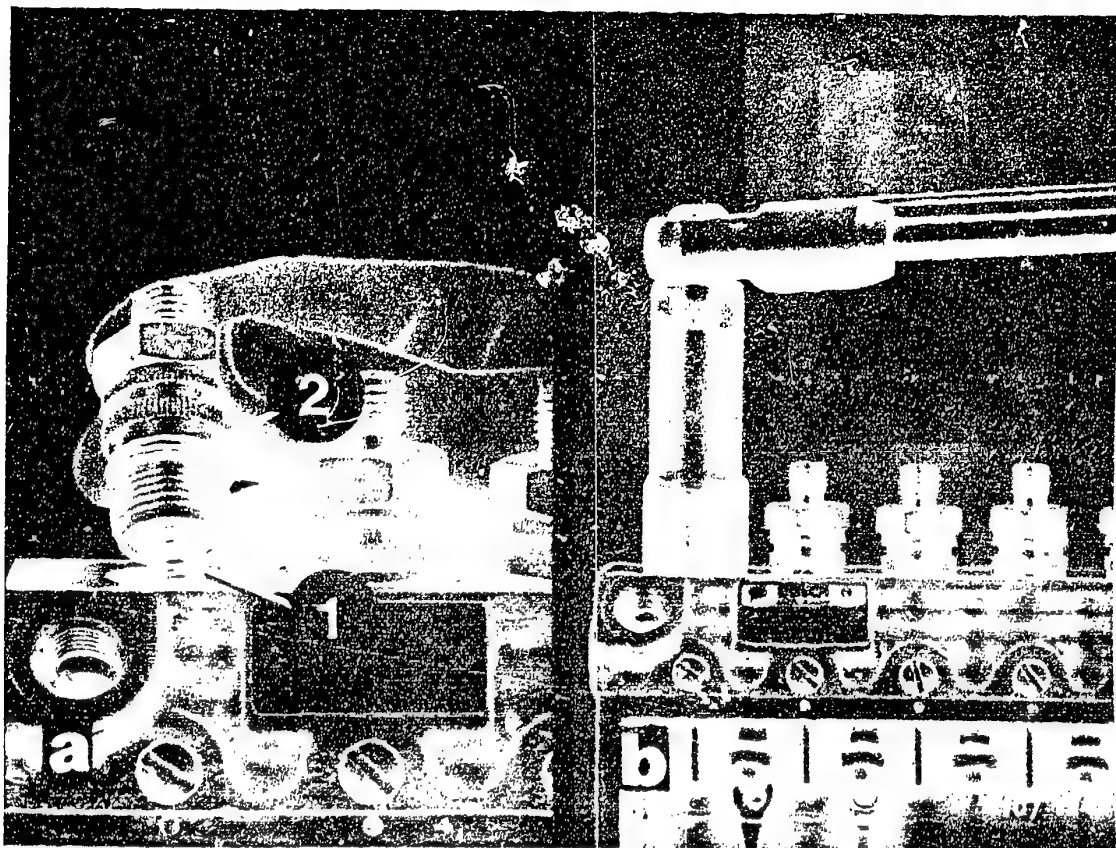
However, this dimension should only be used as a preliminary adjusting dimension; the precise thickness of shims under the delivery-valve spring is established by way of the fuel delivery. The following basic rule applies: The greater the spring preload, the greater the fuel delivery in the upper speed range.

**D 13**

Basic setting

Adjusting/testing PE(S)..A.. pumps





The adjusting/changing of the preload of the delivery-valve spring is performed as follows:

Remove delivery-valve holder from pump housing and remove delivery-valve spring.

Depending on the measurement result for the fuel delivery, insert thinner or thicker shims under the valve spring in the delivery-valve holder.

Insert new seal ring (O-ring). Place valve spring on valve cone.

Place shim and, if applicable, filler piece on spring. Screw delivery-valve holder back into pump housing (picture a).

Depending on version, tighten delivery-valve holder to specified tightening torque and in the specified tightening sequence (see picture b).

**D14**

Basic setting

Adjusting/testing PE(S)..A.. pumps



## Tightening torques for delivery-valve holders

Model	Double seal	
	Delivery-valve holder w/o id. groove Nm	Delivery-valve holder with id. groove Nm
PE(S)..A..C..	45-0-45-0-45..50	-
PE(S)..A..D..	-	40-0-40-0-40...45* 30-0-30-0-33...47**

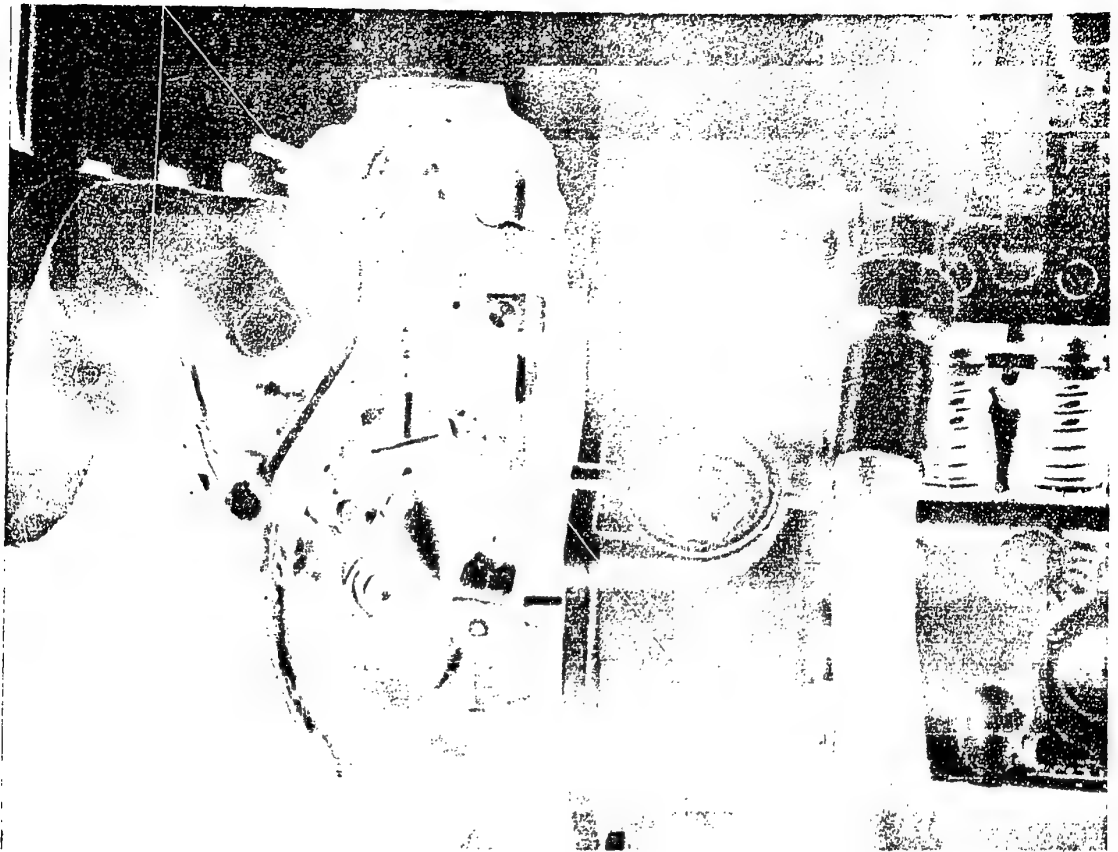
\* for PE(S) 2..6A..D..

\*\* for PE(S) 8..12A..D..

Repeat testing of fuel deliveries.

If necessary, correct again until the specified delivery is obtained.





Again remove the governor cover without parts which was mounted as a protective cover.  
Only mount original governor cover if RQ or RQV governor is mounted.

Re-mount spring-chamber closing cover.  
Tighten screws to 4...5 Nm.

If it is not intended to set the governor, re-mount supply pump, timing device, control-rod stop (manifold-pressure compensator) and control-rod screw plug, if applicable.

Remove pump from test bench.

**D 16**

Basic setting

Adjusting/testing PE(S)..A.. pumps





Mount thermometer with protective tube on inside of vessel. Immerse viscosity test beaker in calibrating oil and leave in the calibrating oil for approx. 15 minutes. This ensures temperature equalization between viscosity test beaker and calibrating oil.

### Testing

Using the chain, pull viscosity test beaker briskly (within approx. 1 sec) out of the calibrating oil (do not swing, keep steady in order to prevent loss of contents).

Start stopwatch when the viscosity test beaker emerges from the calibrating oil.

When the calibrating oil from the funnel-shaped region of the test beaker enters inside into the test beaker bore, stop stopwatch, read off discharge time and note. Repeat viscosity test until identical measurement (tolerance  $\pm 0.3$  s) is obtained.

If an identical result has not been obtained after the 4th repeat, there is dirt (e.g. fluff) in the viscosity test beaker, the collector vessel or the calibrating oil (filter in test bench). See section on Preparations. After this, repeat the test again, as described.

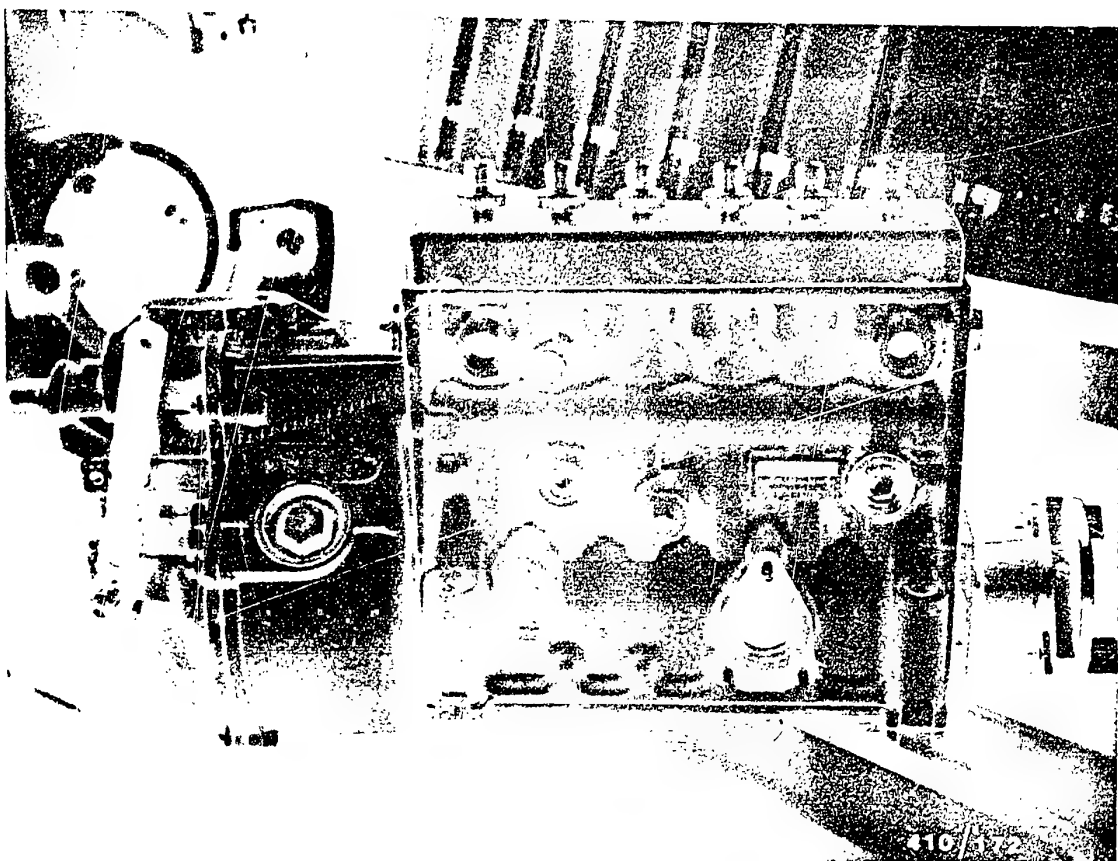
Compare measurement result with values in table.

If the measured time is not within the allowable discharge time tolerance, change the calibrating oil and the calibrating oil filter in the pump test bench.

**A13**

General notes (calibrating oil)  
Adjusting/testing PE(S)..A../PE(S)..P..





## 8. Preparations for adjusting/testing PE(S)..P.. pumps

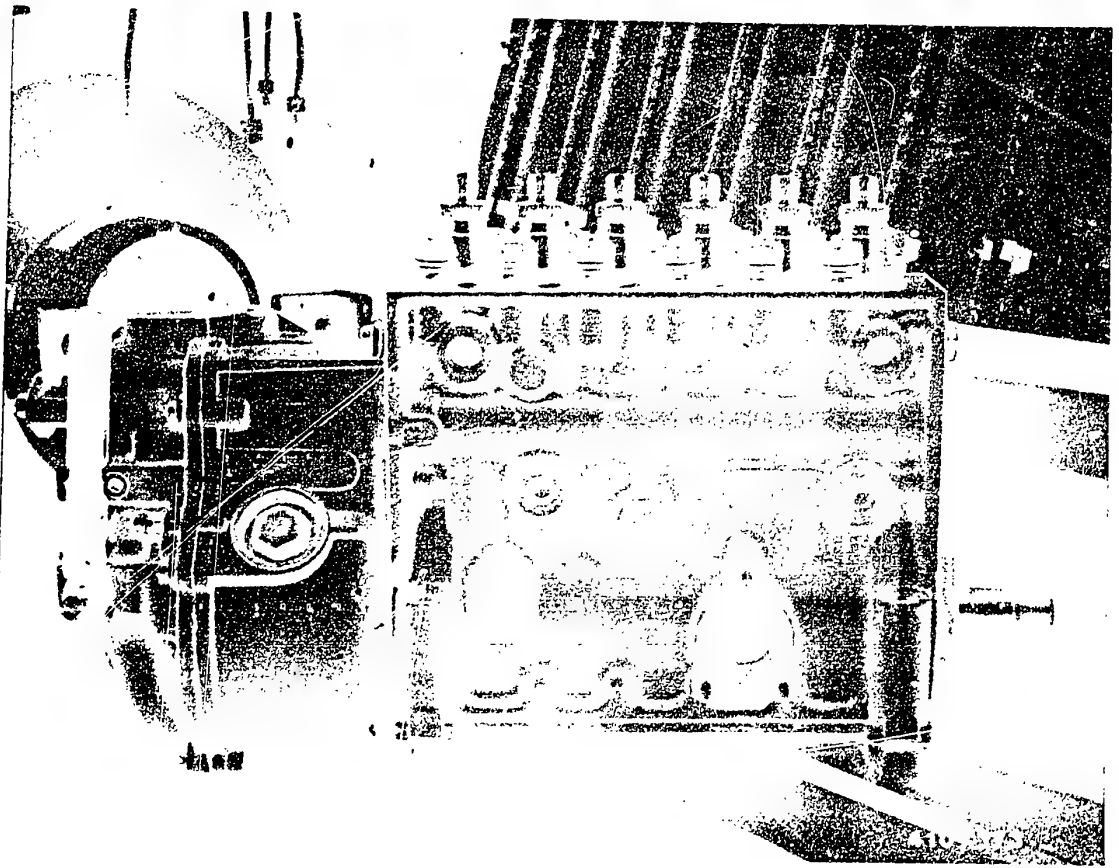
### 8.1 Preparing the pump

Remove supply pump, if applicable. Close the open bore in the injection-pump housing, e.g. with plug 1 900 508 024 (see picture). Remove timing device, if applicable. The special tools required for this can be found on tool board KDEP-T 2000.

**E1**

Preparations for adjusting/testing  
Adjusting/testing PE(S)..P.. pumps





Remove upper closing cover of pump.

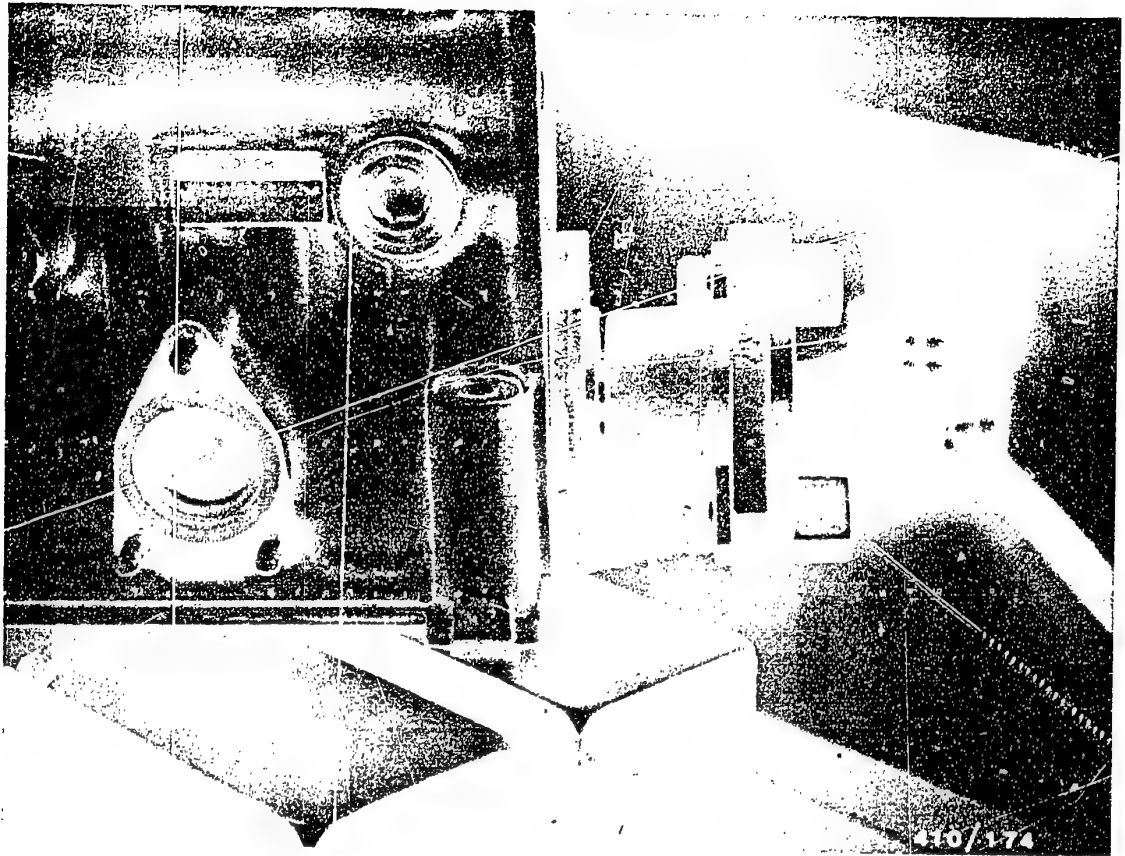
Remove control-rod screw plug or drive-end control-rod stop or manifold-pressure compensator.

Mount appropriate fastening flange on pumps that are mounted by an end flange.

**E2**

Preparations for adjusting/testing  
Adjusting/testing PE(S)..P.. pumps





Depending on the type of drive, mount the appropriate coupling part on the drive cone of the camshaft. A claw-type coupling half is mounted in place of a gear or timing device to suit the diameter of the cone:

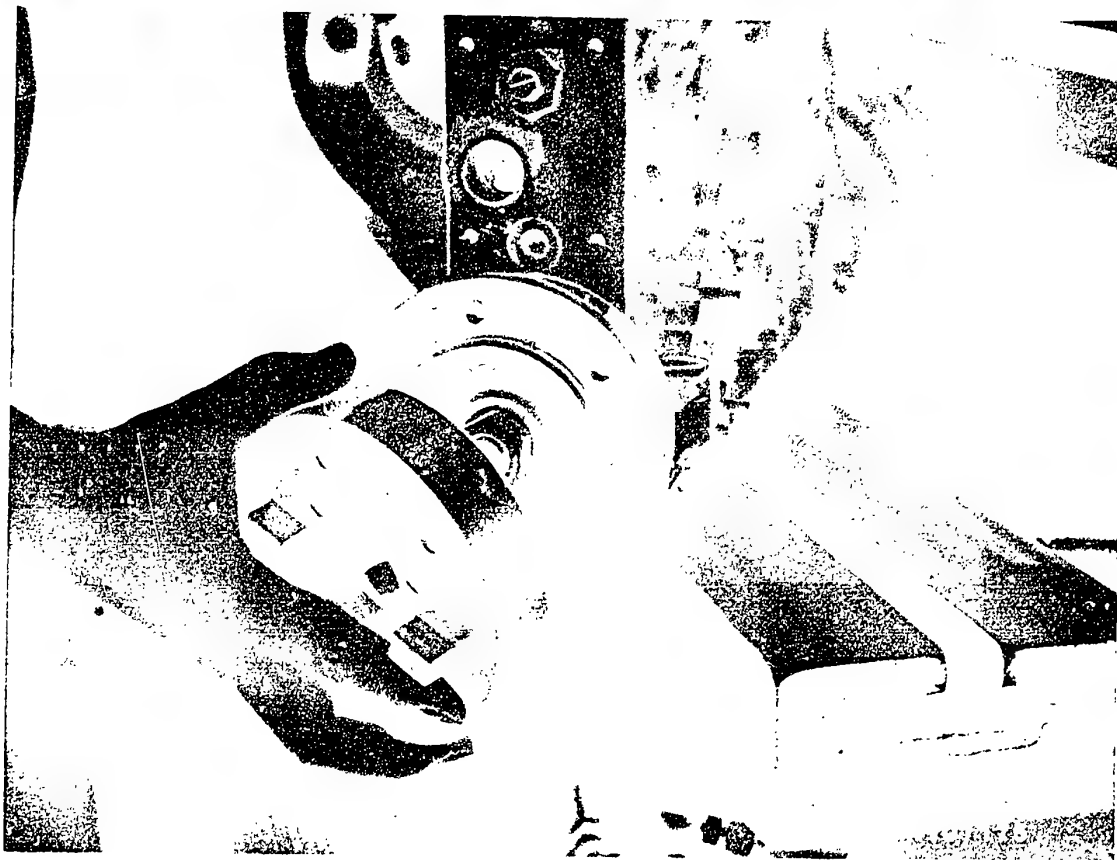
- For cone diameter 17 mm - 1 416 430 012
- for cone diameter 20 mm - 1 416 430 017
- for cone diameter 25 mm - 1 686 430 007
- for cone diameter 30 mm - 1 686 430 012
- for cone diameter 35 mm - 1 686 430 017

If the injection pump is driven on the engine with a multi-plate clutch, this remains mounted on the camshaft. In this case, remove the multi-plate clutch of the test bench and replace with a rigid drive part.

**E3**

Preparations for adjusting/testing  
Adjusting/testing PE(S)..P.. pumps





If there is a flange on the camshaft for mounting a drive gear, mount combined puller and driving device KDEP 1557 on this flange.

**E4**

Preparations for adjusting/testing  
Adjusting/testing PE(S)..P.. pumps



## 8.2 Preparing the injection-pump test bench

Injection pumps are to be tested only on the approved test bench for the respective injection pump with corresponding accessories.

The calibrating nozzle-and-holder assembly and calibrating fuel-injection tubing specified for setting the respective injection-pump assembly, as well as the suction-gallery pressure and the overflow valve are to be taken from the test specifications.

The calibrating oil must conform to the regulations on its usability in the test bench (in particular its viscosity).

**E5**

Preparing the injection-pump test bench  
Adjusting/testing PE(S)..P.. pumps





The clamping supports and/or clamping brackets required for mounting the injection pump should be placed on the test-bench clamping rail, but not screwed down at this stage.

**E6**

Preparing the injection-pump test bench  
Adjusting/testing PE(S)..P.. pumps



Pick out the appropriate connecting parts (inlet union and inlet-union screw) for the connection thread of the injection pump and for the inlet hose of the injection-pump test bench, and mount/hold ready.

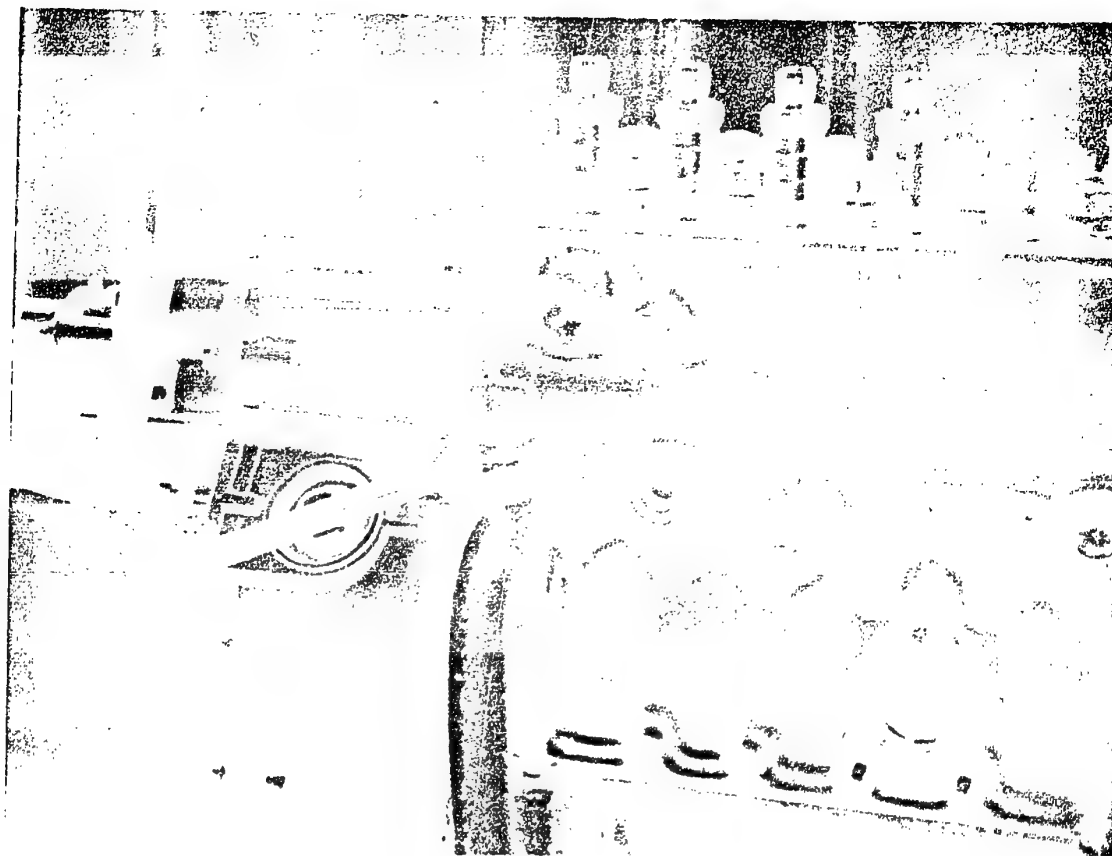
If there is a multi-plate clutch on the drive cone of the injection-pump camshaft, remove the clutch on the test bench and replace with a rigid drive part which is mounted on the flywheel.

**E7**

Preparing the injection-pump test bench  
Adjusting/testing PE(S)..P.. pumps







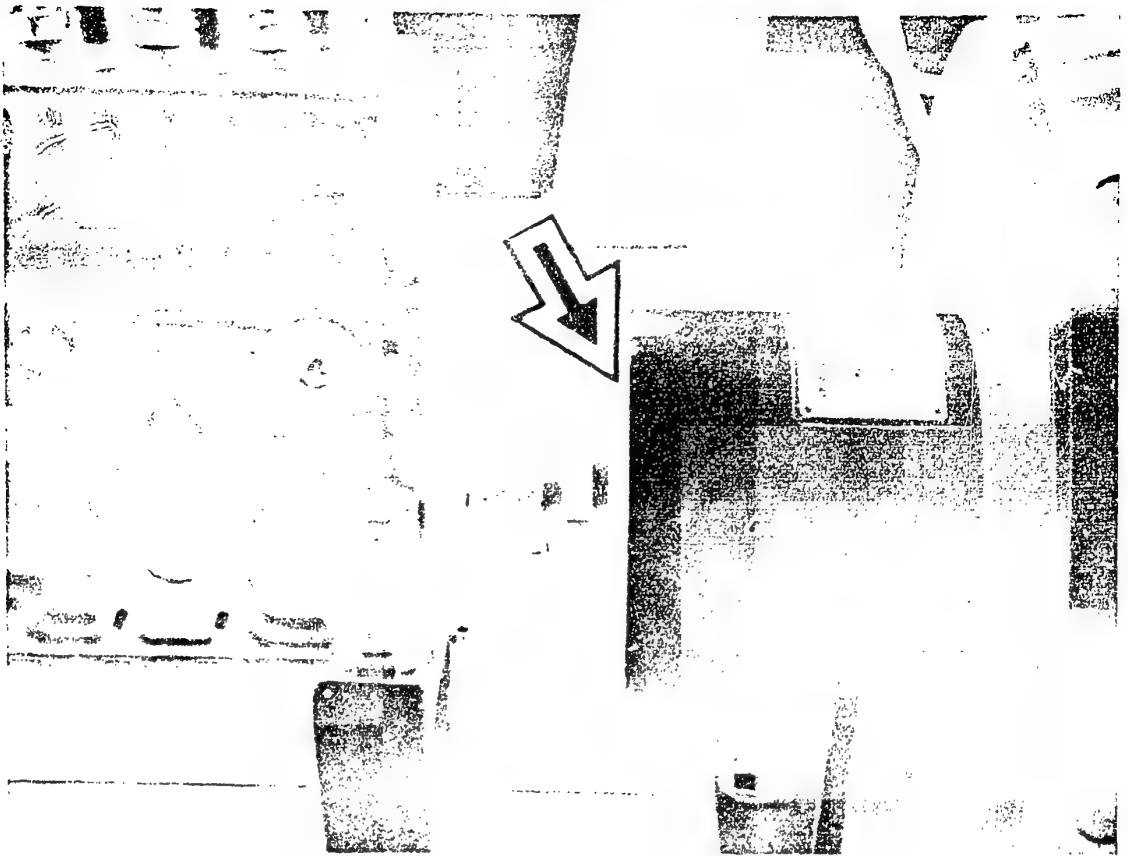
### 8.3 Mounting the injection-pump assembly

Place the injection-pump assembly on the prepared clamping parts and screw down.

Note:

Do not position the two clamping brackets on the same pump side.





If the injection pump is driven by a claw-type coupling half, slide the mounted pump assembly toward the test bench coupling until the claws of the coupling half on the pump are between the clamping jaws of the test bench coupling. A gap of approx. 1 mm is essential between coupling half and clamping jaws (see picture, arrow). Tighten fastening screws of clamping supports/brackets. Firmly clamp coupling half in test bench coupling.

**E9**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..P.. pumps

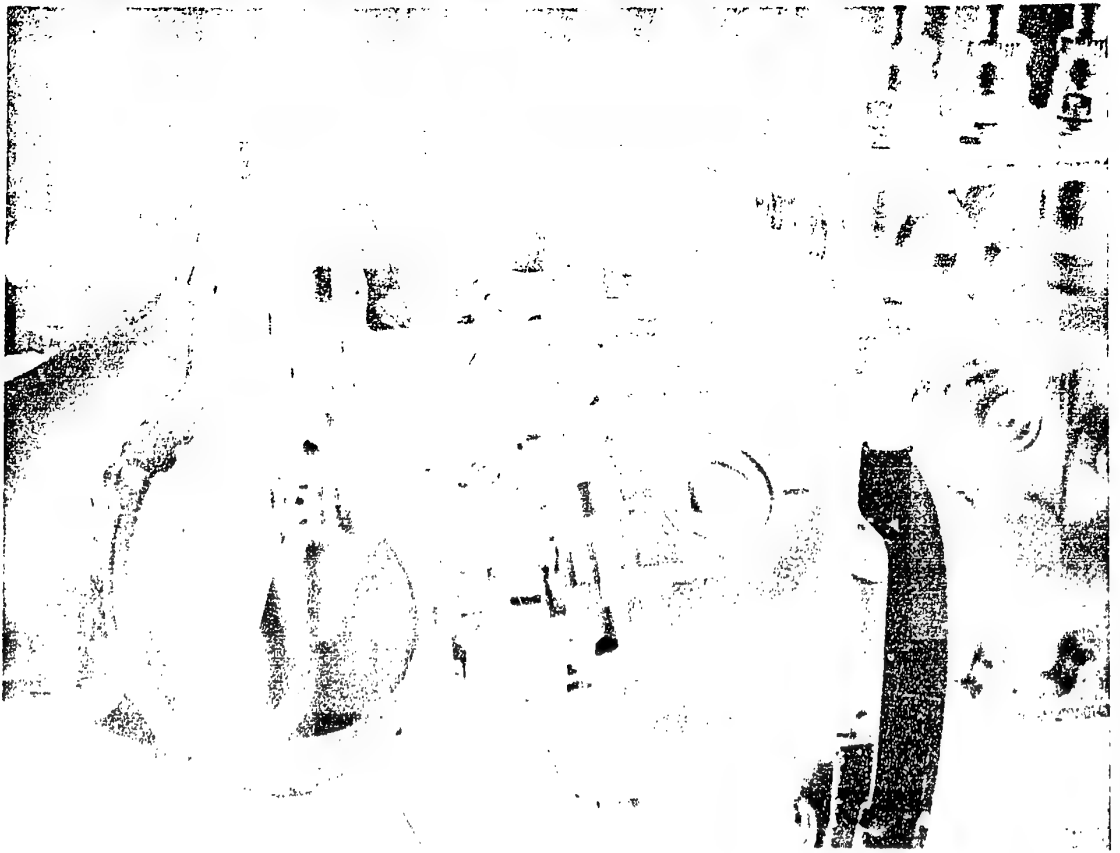


If the injection pump is driven by a multi-plate clutch, slide the mounted pump assembly until multi-plate clutch and rigid drive part on test bench touch. Screw multi-plate clutch onto rigid drive part and tighten to the specified tightening torque (depends on test bench). Secure clamping supports/brackets on clamping rail of injection-pump test bench.

**E10**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..P.. pumps



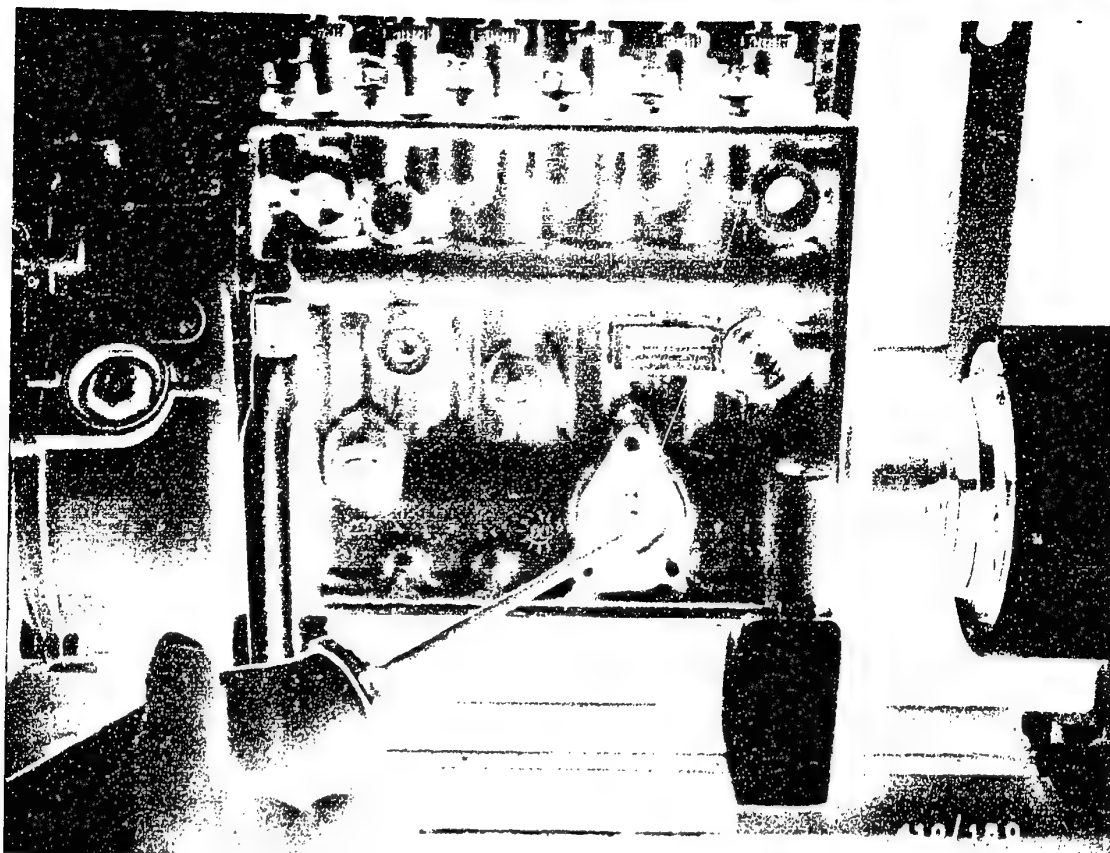


Remove governor cover (catch escaping oil), and replace by appropriate cover without additional part. This is necessary in order to prevent coming into contact with revolving governor components during adjusting.

**E11**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..P.. pumps





Pour the specified quantity of lubricating oil (engine oil) into the injection-pump assembly (see picture).  
Quantity in liters:

Pump with governor	Number of pump cylinders							
	2	3	4	5	6	8	10	12
RQ(V)	-	-	0.75	-	0.85	0.95	1.1	1.3
RSV	-	-	0.4	-	0.5	0.6	0.75	0.9
RZU	-	-	0.85	-	0.95	1.1	1.3	1.5
RSUV	-	-	1.0	-	1.1	1.2	1.5	1.7
w/o governor	-	-	0.25	-	0.35	0.5	0.7	0.9

**E12**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..P.. pumps

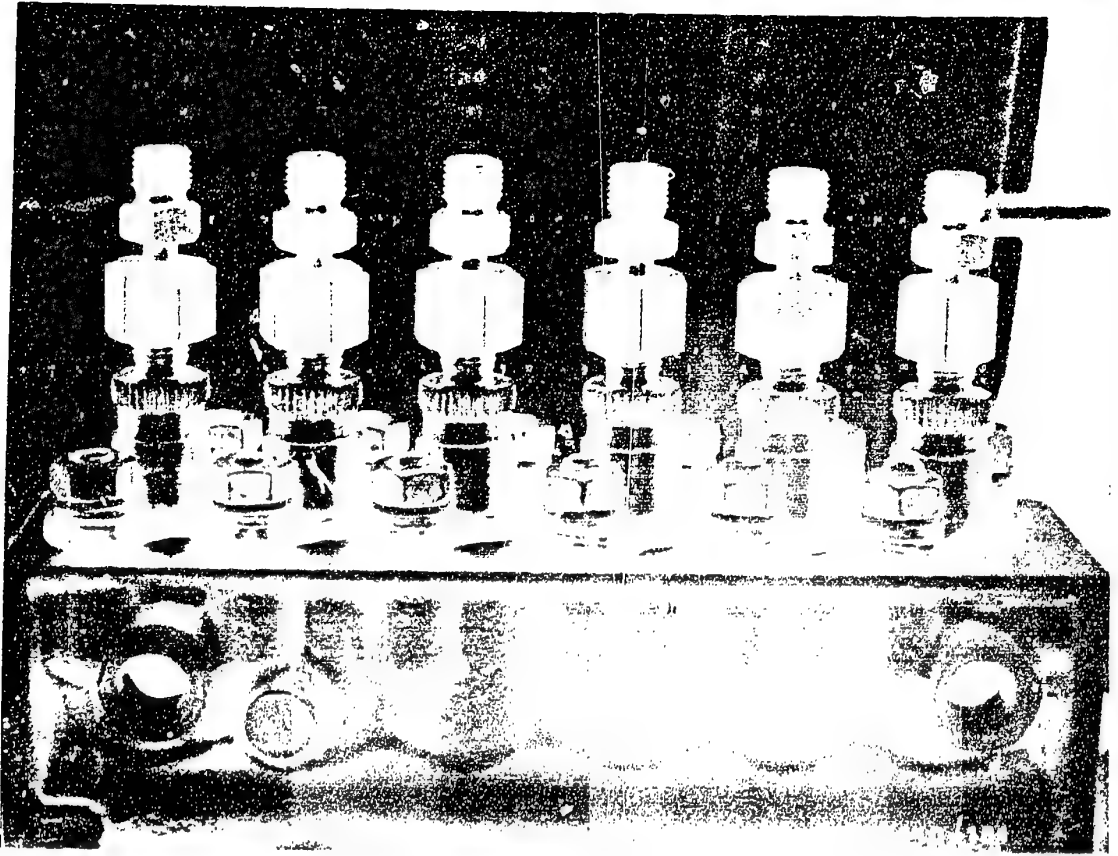


Test specifications for the corresponding pump-governor combination can be found in microcard WP.. .

**E13**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..P.. pumps



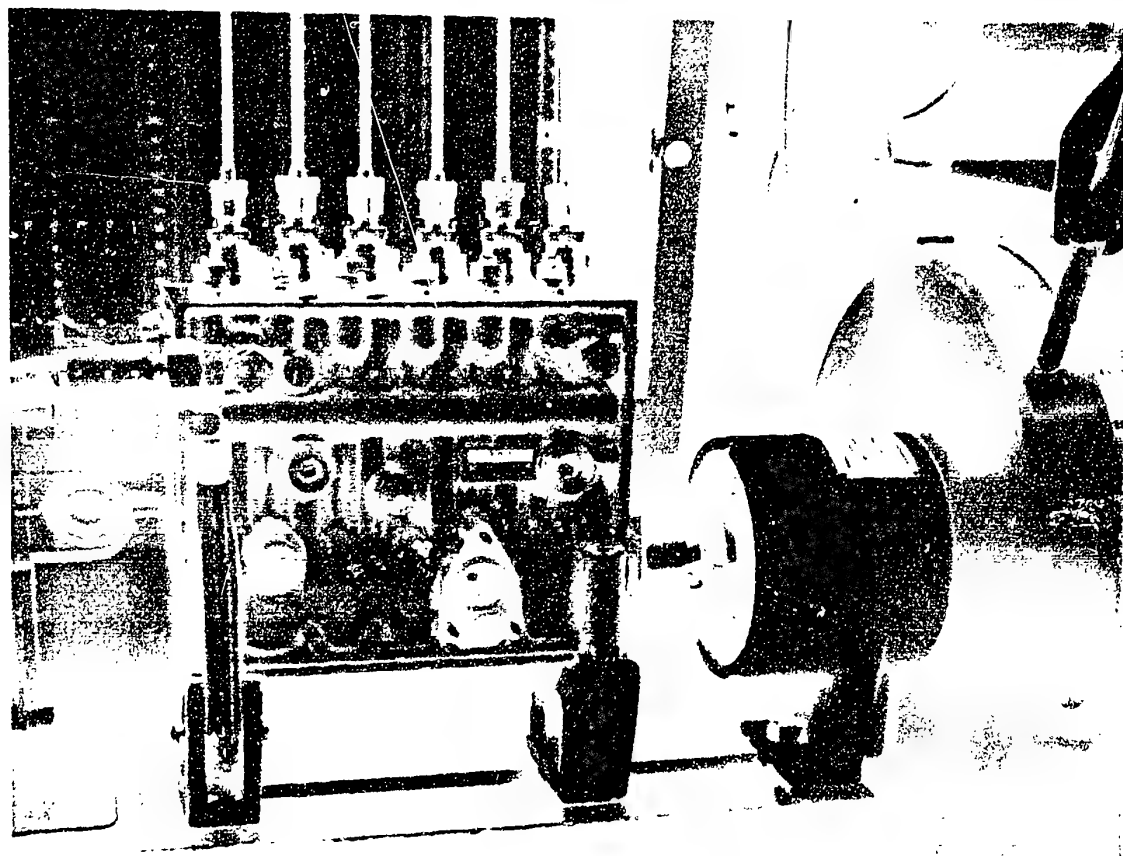


Provide injection pumps with inch thread on delivery-valve holder with specially provided connecting pieces 1 683 391 118 or 1 683 391 119.

**E14**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..P.. pumps





Secure calibrating fuel-injection tubing on delivery-valve holders of injection pump.

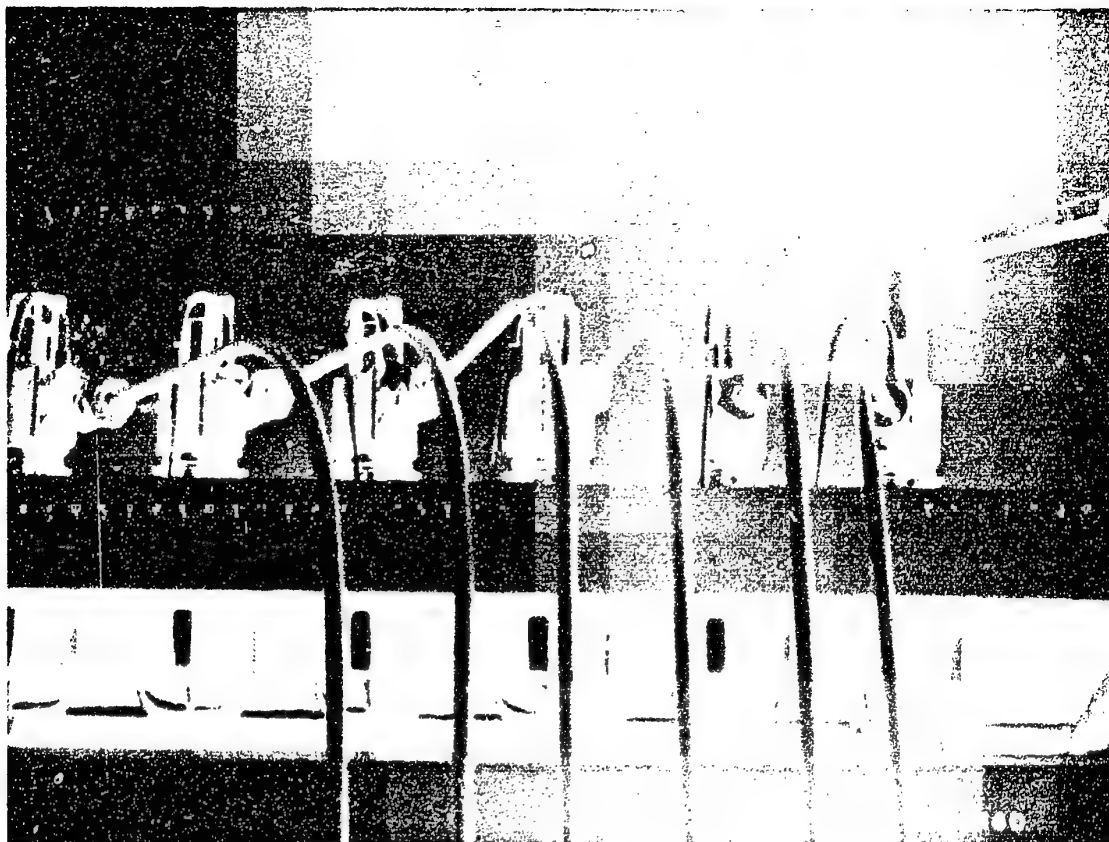
Using appropriate inlet-union screw, mount inlet hose of injection-pump test bench on fuel inlet of injection pump (identifiable by the Helicoil insert). Further threaded bores of the pump suction gallery, which serve to accommodate overflow valves, are dummy-sealed with screw plugs and copper seal ring. To ensure that the pump drive does not block, turn the camshaft over several times by turning the flywheel by hand.

**E15**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..P.. pumps





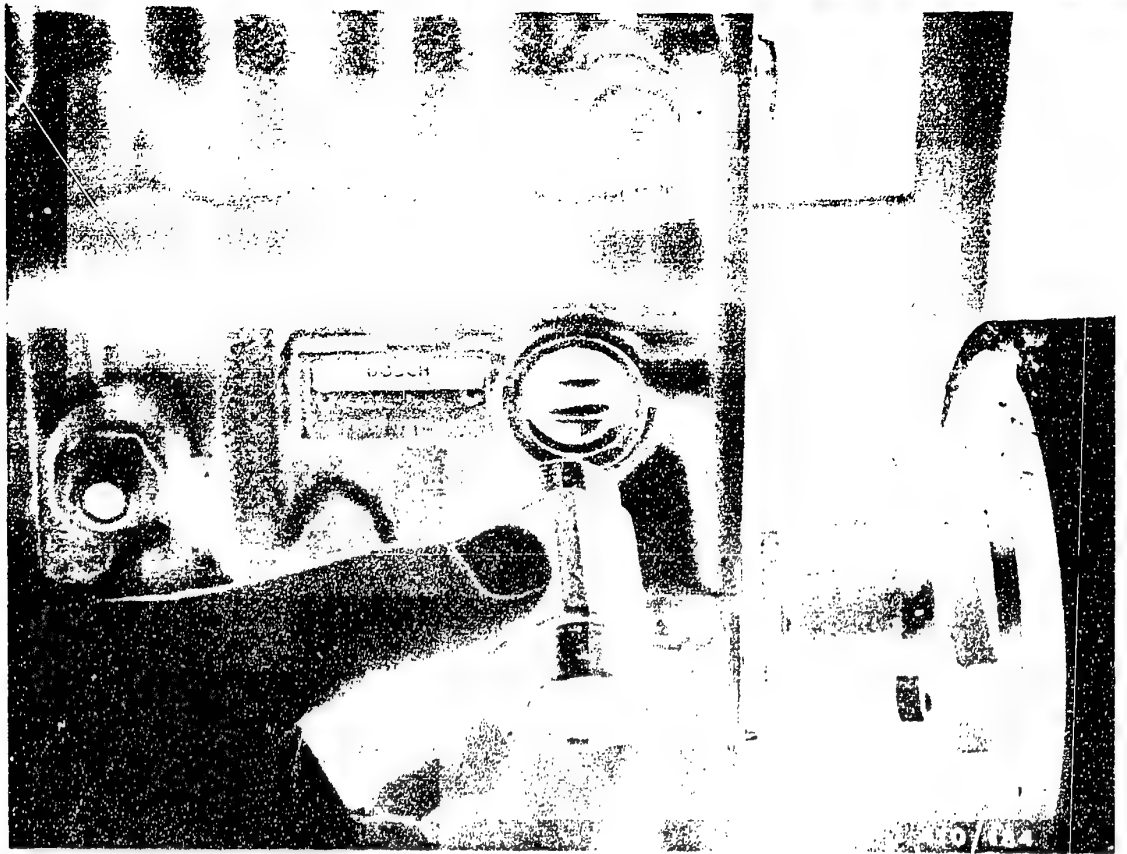


Open screw plugs on overflow pipes of all calibrating nozzle holders (see picture).  
Bring control rod into shutoff position. Switch on test bench and set high pressure of calibrating oil.  
Calibrating oil escapes from the overflow pipes of the calibrating nozzle holders. The initial foaming must slowly cease. As soon as the calibrating oil escapes free of foam, switch off the test bench and re-close the screw plugs of the overflow pipes.

**E16**

Mounting the injection-pump assembly  
Adjusting/testing PE(S)..P.. pumps





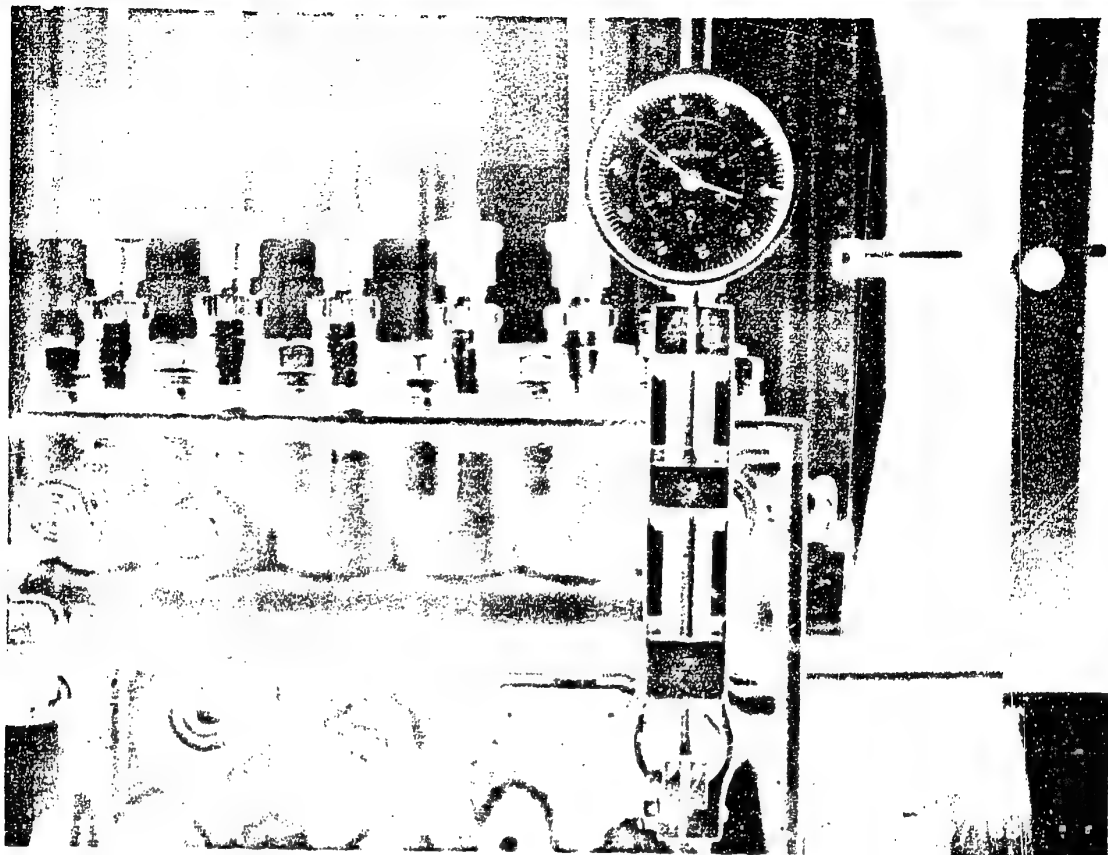
### 9. Measuring/adjusting the prestroke

Bring transmission of injection-pump test bench to neutral. Unscrew screw plug of threaded bore for receiving the prestroke measuring device. Screw threaded sleeve into open threaded bore (see picture) and tighten.

**E17**

Adjusting the prestroke  
Adjusting/testing PE(S)..P.. pumps





Insert prestroke measuring device and clamp on the already inserted threaded sleeve.

The measuring pin of the device rests on the roller tappet.

Insert dial indicator 1 687 233 012 into the prestroke measuring device.

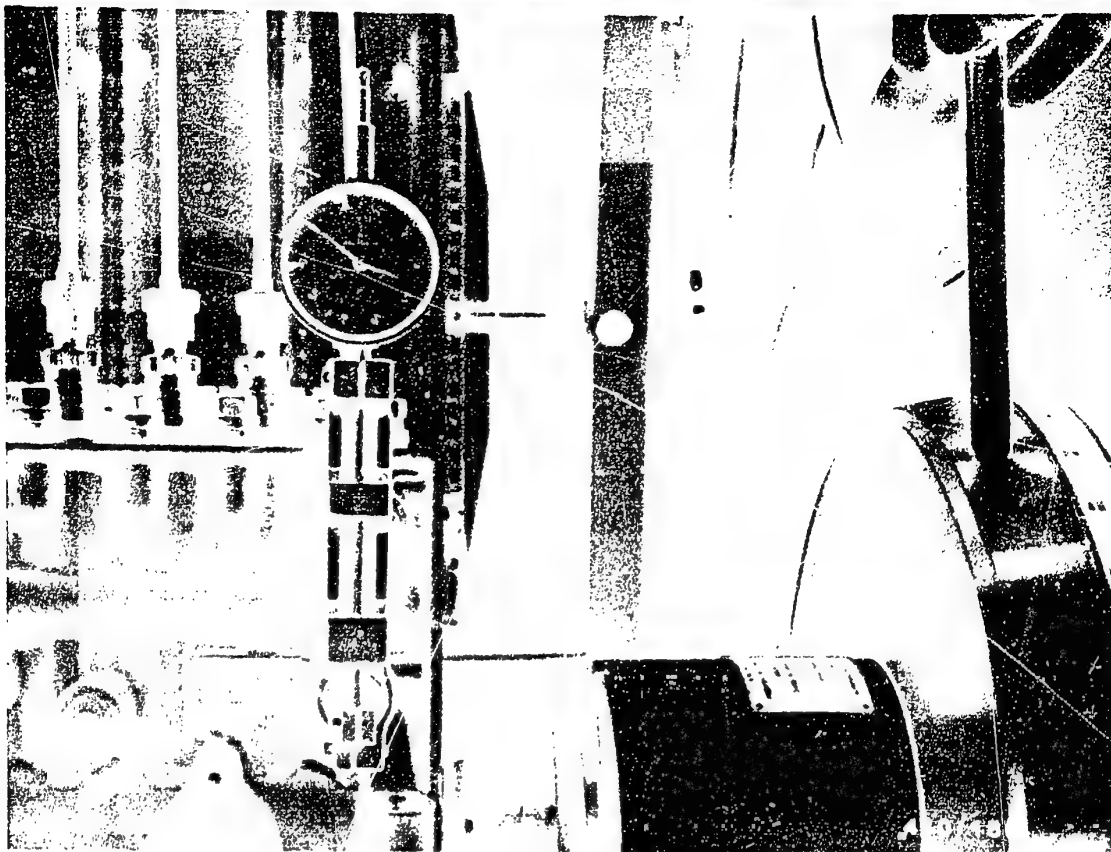
Turn injection-pump camshaft until the tappet behind the prestroke measuring bore has assumed a position so low that the prestroke measuring device can be introduced.

**E18**

Adjusting the prestroke

Adjusting/testing PE(S)..P.. pumps





Turn test bench flywheel by hand in the pump direction of rotation until the roller tappet nearest the pump drive is at BDC (see picture).

Set dial indicator to "0".

Note:

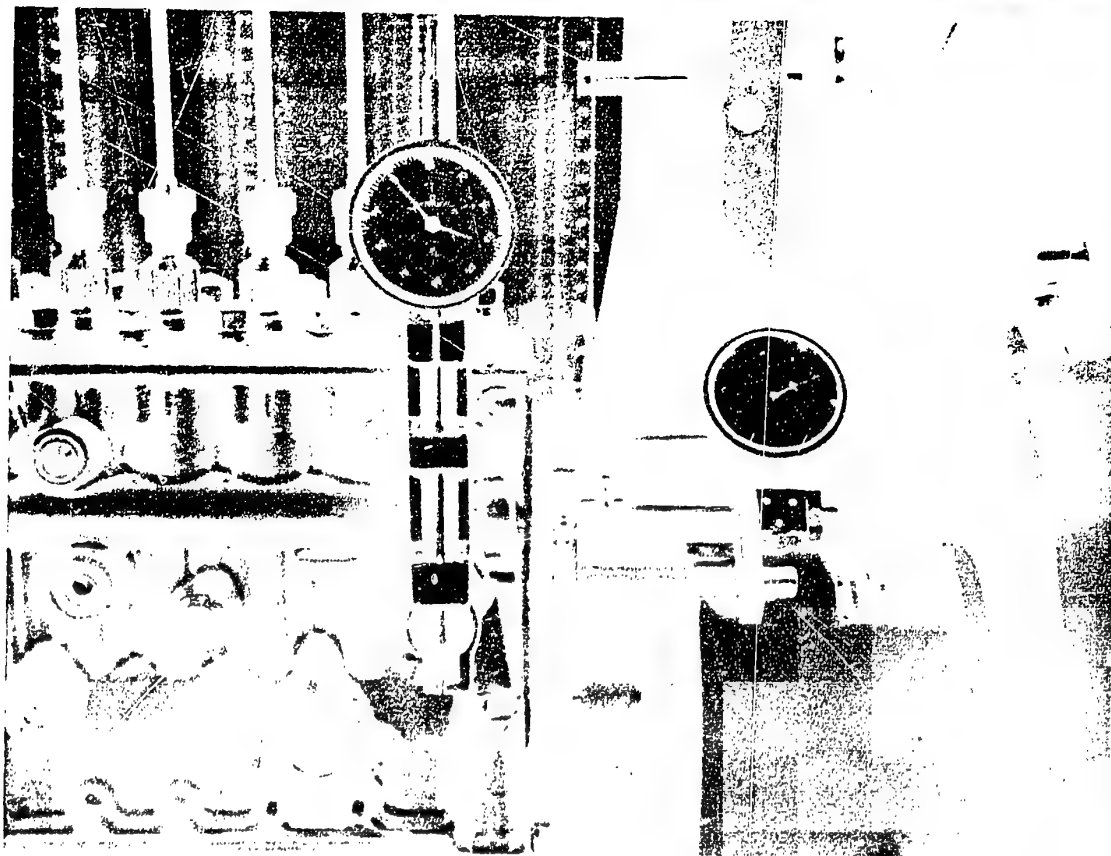
If the prestroke adjustment is made on a different roller tappet, this is to be taken from the test specifications and this roller tappet should be brought to BDC.

**E 19**

Adjusting the prestroke

Adjusting/testing PE(S)..P.. pumps





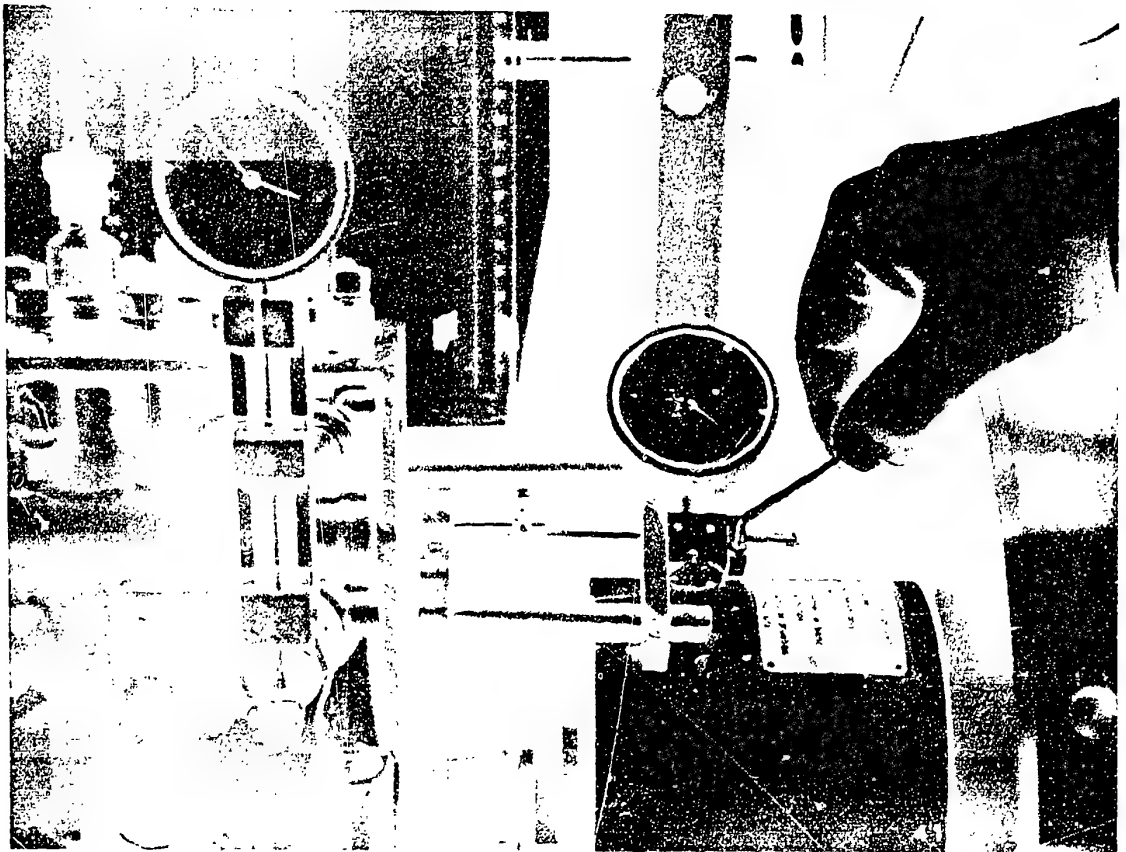
Mount control-rod-travel measuring device.  
Slide injection-pump control rod in the direction of the governor as far as the mechanical stop.  
In this position, set the dial indicator of the control-rod-travel measuring device to "0".

**E20**

Adjusting the prestroke

Adjusting/testing PE(S)..P.. pumps





Slide control rod in the "start" direction until the dial indicator of the control-rod-travel measuring device indicates the control-rod travel specified in the test-specification sheet for adjusting the prestroke. In this position, fix control rod on control-rod-travel measuring device with clamping device (see picture).

Note:

If, in older test specifications, no control-rod travel is specified for measuring the prestroke, set the control-rod travel which is inside a frame and which is specified for the basic setting of the pump.

If the pump has plunger-and-barrel assemblies with upper helix, the prestroke is not set until after the basic setting of the pump.

**E21**

Adjusting the prestroke

Adjusting/testing PE(S)..P.. pumps



Switch on the injection-pump test bench and, on the test bench, set the high pressure required for adjusting the prestroke. Calibrating oil begins to flow from the open overflow pipe of the calibrating nozzle holder.

Turn flywheel of injection-pump test bench by hand in pump direction of rotation.

Note:

Direction of rotation is contained in the type designation of the injection pump. Example: PE6P120A720LS 3807

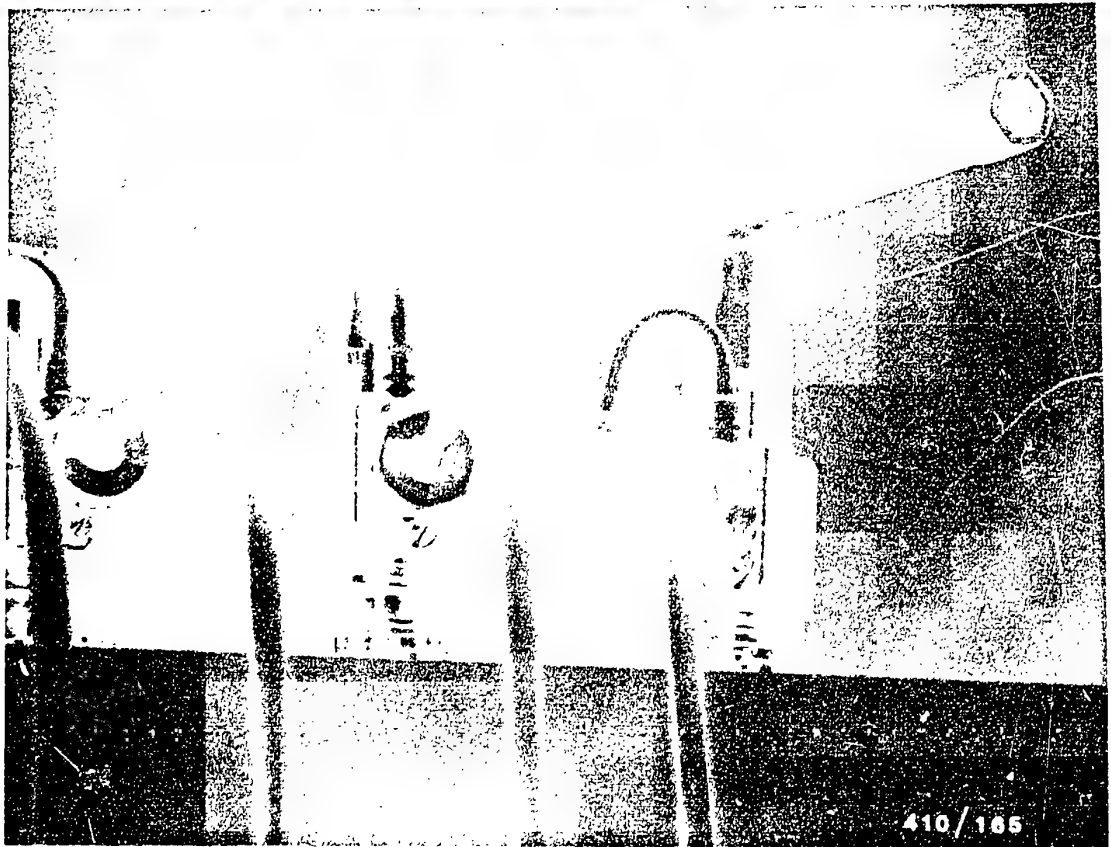
The underlined letter indicates the direction of rotation - looking onto the drive of the pump (R/L = right/left = clockwise/counter-clockwise).

**E22**

Adjusting the prestroke

Adjusting/testing PE(S)..P.. pumps





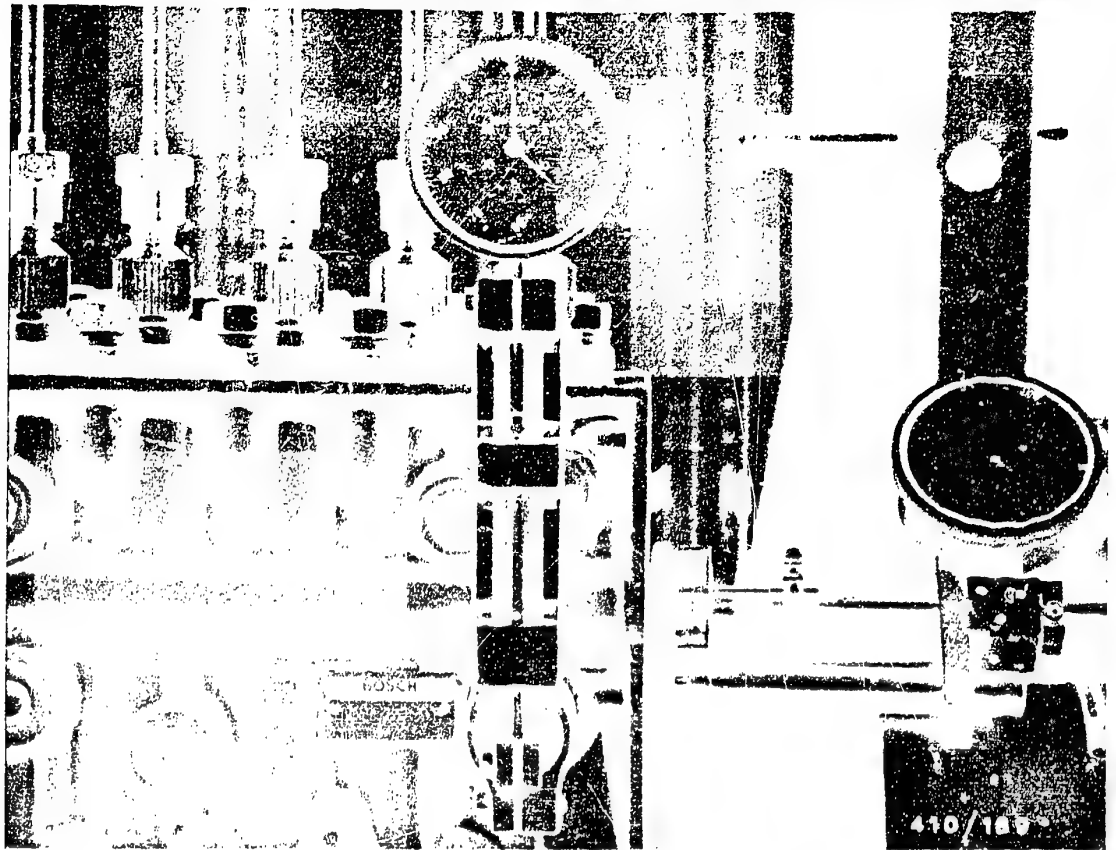
When the flow of calibrating oil from the overflow pipe of the calibrating nozzle holder changes into a chain of drops (see picture), take the reading from the dial indicator of the prestroke measuring device. The reading is the prestroke.

**E23**

Adjusting the prestroke  
Adjusting/testing PE(S)..P.. pumps







If the reading does not agree with the value given in the test specifications, proceed as follows:  
Switch off the test bench. Unscrew the calibrating fuel-injection tubing from the delivery-valve holder of the plunger-and-barrel assembly under test.  
Loosen fastening nuts of flange bushing of plunger-and-barrel assembly.

**E24**

Adjusting the prestroke

Adjusting/testing PE(S)..P.. pumps



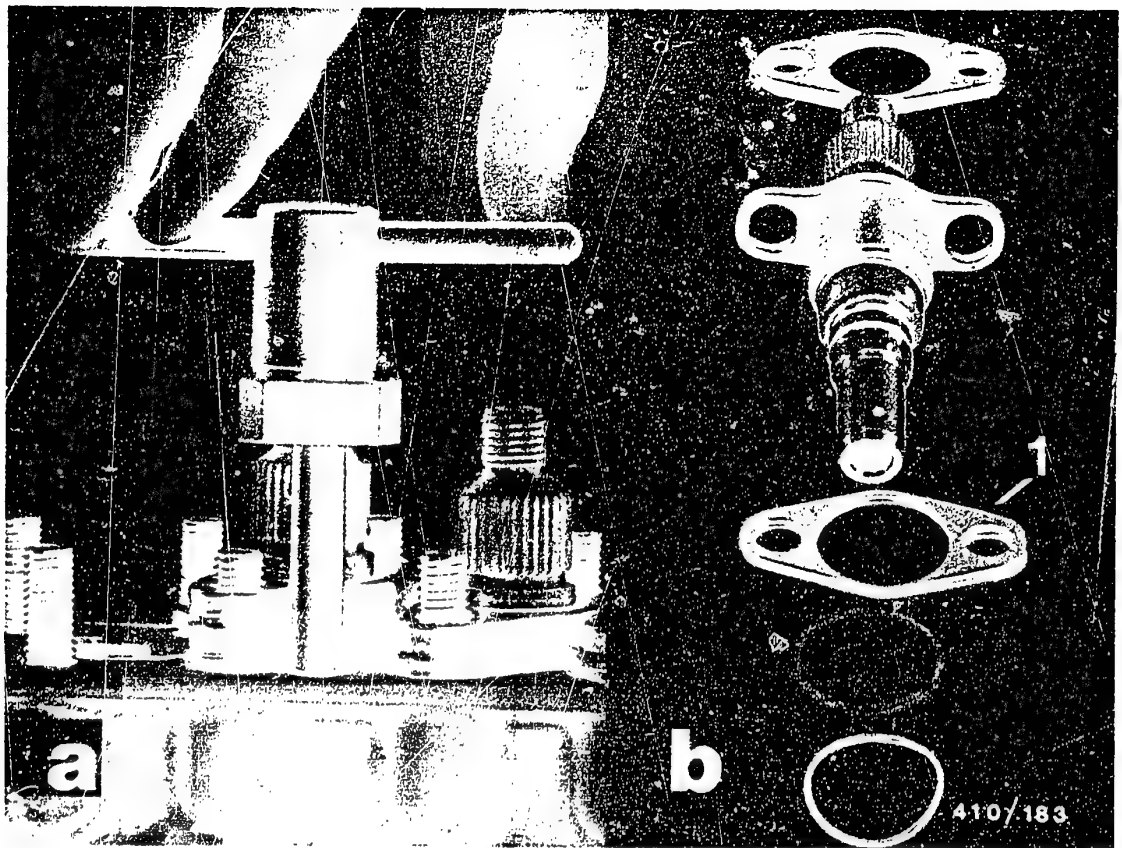
## Viscosity test

Oil temperature in °C	Allowable discharge time (sec)
10	82.0 ... 89.5
11	81.0 ... 88.5
12	80.5 ... 87.5
13	80.0 ... 86.5
14	79.0 ... 86.0
15	78.5 ... 85.0
16	78.0 ... 84.0
17	77.5 ... 83.0
18	77.0 ... 82.0
19	76.5 ... 81.5
20	75.5 ... 80.5
21	75.0 ... 79.5
22	74.5 ... 79.0
23	74.0 ... 78.0
24	73.5 ... 77.5
25	73.0 ... 77.0
26	72.5 ... 76.0
27	72.0 ... 75.5
28	71.5 ... 75.0
29	71.0 ... 74.5
30	70.5 ... 74.0

**A14**

General notes (calibrating oil)  
Adjusting/testing PE(S)..A../PE(S)..P..





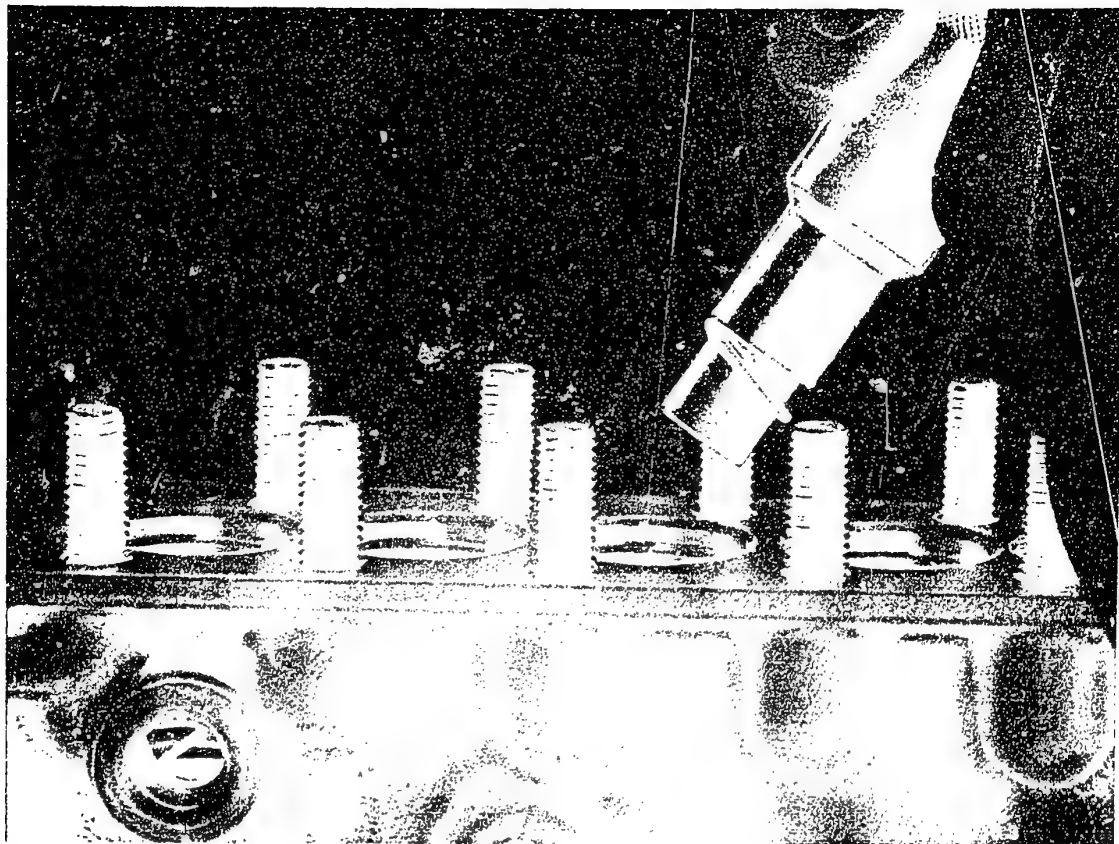
On pumps with one-part prestroke adjusting shims, pull barrel-and-valve assembly out of pump housing using puller KDEP 2911 (see picture a). Replace prestroke adjusting shim (1) with identical shim of different thickness. The thickness of the shim to be used results from the dimensional difference between the specified prestroke and the measured prestroke. If the measured prestroke is greater than the one specified in the test-specification sheet, use a thinner prestroke adjusting shim; if the prestroke is too small, use a thicker prestroke adjusting shim.

**F1**

Adjusting the prestroke

Adjusting/testing PE(S)..P.. pumps





Installing the flange-bushing plunger-and-barrel assembly

Inserting the lower O-ring

Using insertion device KDEP 2884, insert the lower O-ring (as per service-parts list) of the flange-bushing plunger-and-barrel assembly. Rub tallow into O-ring. Depress the ram of the device and slip the O-ring onto the projection sleeve (see picture). Insert device and release ram.

Note:

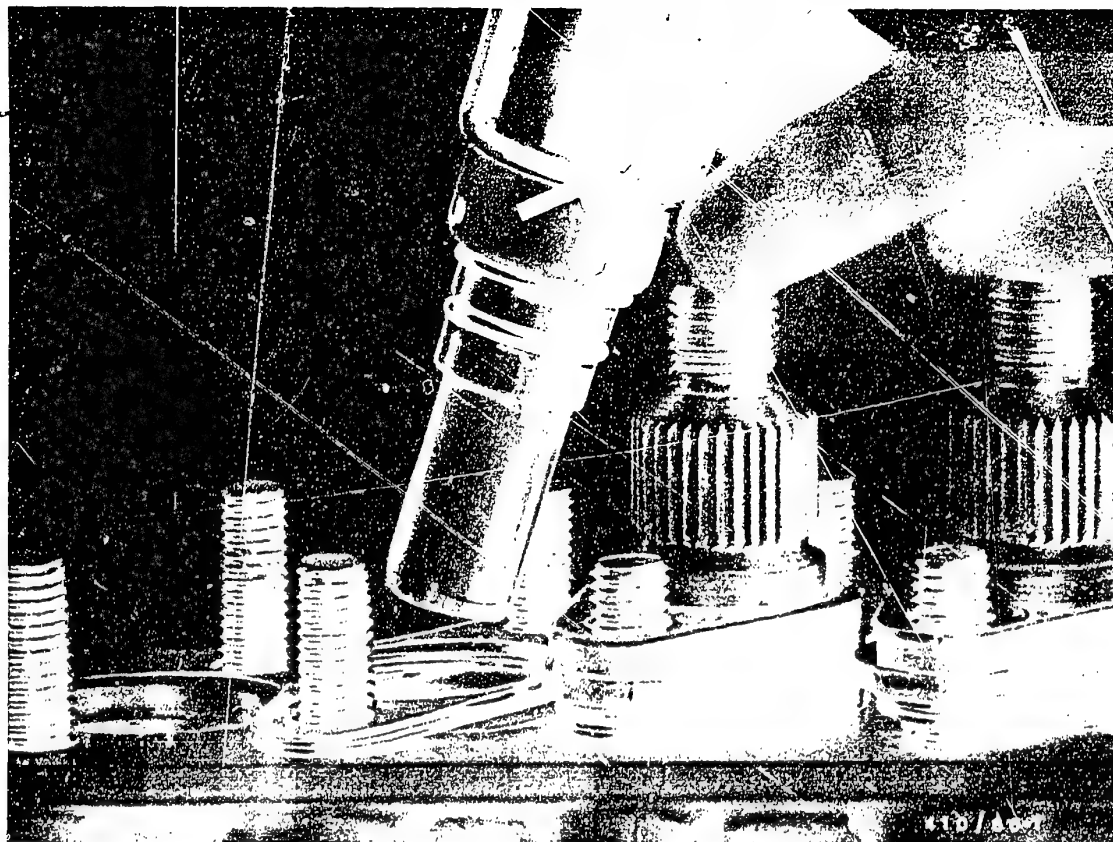
Do not mount O-ring by slipping onto flange-bushing plunger-and-barrel assembly together with barrel-and-valve assembly.

O-ring will be damaged.

**F2**

Adjusting the prestroke  
Adjusting/testing PE(S)..P.. pumps





Inserting the flange-bushing plunger-and-barrel assembly

(Series P..1/P..1000/P..3000)

When inserting, the notches of the flange bushings (see picture, arrow) point toward the control rod (back of pump).

Note:

Use only the correct O-ring as per service-parts list for the respective pump version (different diameters, 28 and 30 mm).

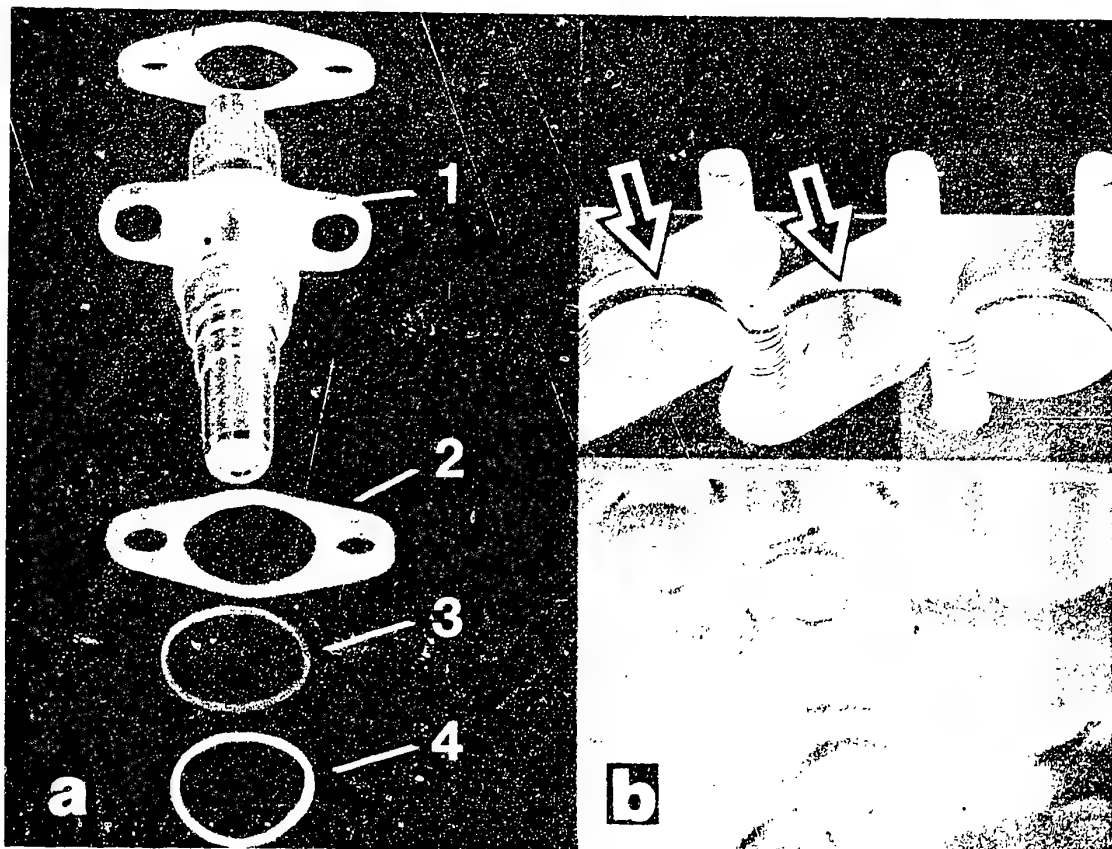
Rub tallow into O-rings.

**F3**

Adjusting the prestroke

Adjusting/testing PE(S)..P.. pumps





- 1 = Flange bushing
- 2 = Prestroke adjusting shims (1 or 2 part)
- 3 = Spacer ring
- 4 = O-ring

If O-rings of 28 mm diameter are used, slip prestroke adjusting shims, spacer ring and O-ring onto flange bushing of barrel-and-valve assembly and insert barrel-and-valve assembly (see picture a).

If the large O-ring (30mm diameter) is used, insert O-ring and spacer ring into pump housing before installing the barrel-and-valve assembly (see picture b, arrows). Put on the prestroke adjusting shims (see picture b).

**F4**

Adjusting the prestroke

Adjusting/testing PE(S)..P.. pumps



If, when inserting the barrel-and-valve assemblies, major resistance can be felt, check the position of the O-rings.

Do not use force to press in the barrel-and-valve assembly. So as not to shear off any of the O-rings, move the barrel-and-valve assembly in the area of the slots by employing light pressure from above with the aid of box wrench KDEP 2997. Then turn the barrel-and-valve assemblies so that the stay bolts are in the center of the slots.

**F5**

Adjusting the prestroke

Adjusting/testing PE(S)..P.. pumps





Put on pressure plates and spring lock washers.  
Screw on hexagon nuts and tighten to a torque of 40...  
45 Nm.

**F6**

Adjusting the prestroke

Adjusting/testing PE(S)..P.. pumps





In the case of pumps with two-part prestroke adjusting shims, slightly raise the barrel-and-valve assembly after loosening the fastening nuts and take out the prestroke shims. Replace prestroke shim with two identical shims of different thickness.

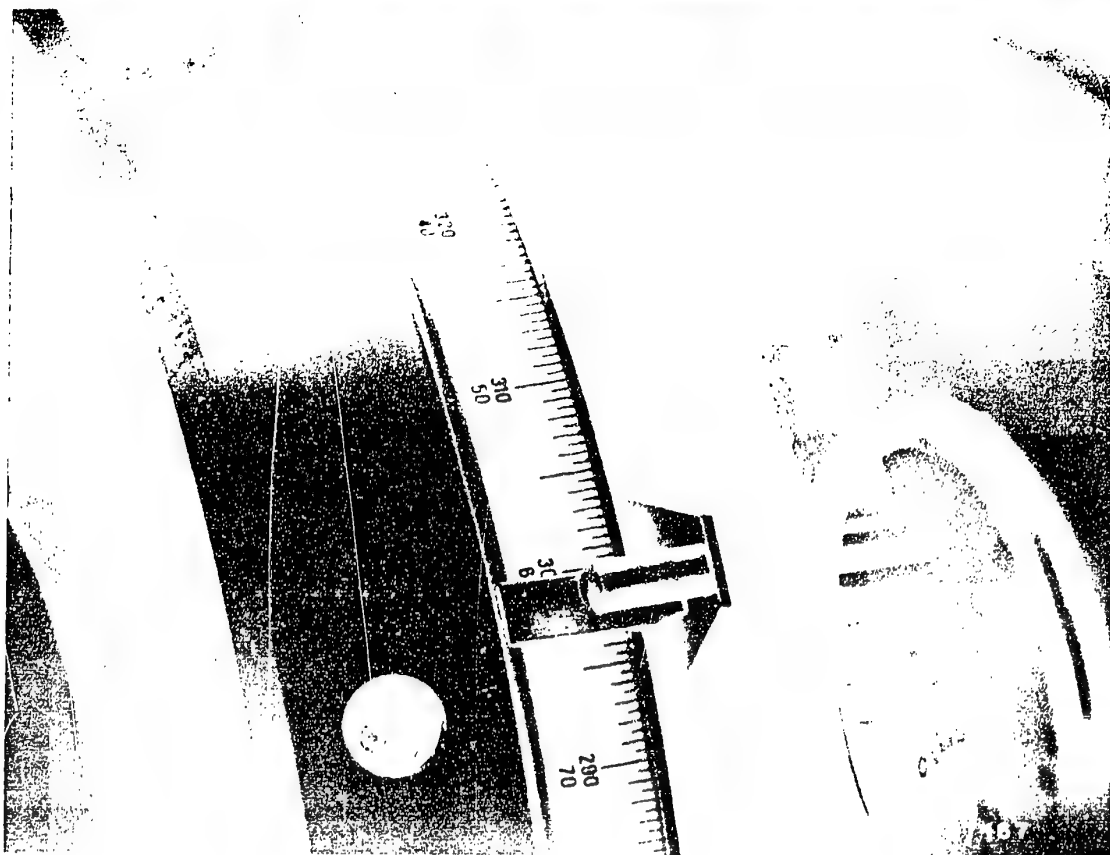
The thickness of the shim to be used results from the dimensional difference between the specified prestroke and the measured prestroke. If the measured prestroke is greater than the prestroke given in the test-specification sheet, use thinner prestroke adjusting shims; if the prestroke is too small, use thicker prestroke adjusting shims. Make sure that two shims of equal thickness are always used.

**F7**

Adjusting the prestroke

Adjusting/testing PE(S)..P.. pumps





Switch on the injection-pump test bench and measure the prestroke by turning the flywheel of the pump test bench by hand as specified.

If the reading still does not agree with the value given in the test-specification sheet, repeat the prestroke adjustment. When the prestroke has been correctly adjusted, first of all hold the flywheel in this position and set the pointer on the pump test bench flywheel to an "even" number (divisible by 10). This makes it easier subsequently to measure the start-of-delivery spacing. Remove the prestroke measuring device.

Screw screw plug back in. Tightening torque = 40...60Nm.

**F8**

Adjusting the prestroke

Adjusting/testing PE(S)..P.. pumps



## 9.1 Adjusting the start-of-delivery spacing

Close the overflow pipe of the calibrating nozzle holder of the barrel under test. Open the overflow pipe of the next barrel in the cam sequence.

Turn camshaft in the specified direction of rotation until the flow of fuel changes into a chain of drops. Read off the number of degrees on the pointer on the flywheel of the test bench and subtract from this figure the value to which the pointer was set previously with the preceding barrel in the start-of-delivery position.

Example:

Cam sequence 1-5-3-6-2-4

Start-of-delivery spacing: 0-60-120-180-240-300-360°  
cam angle

Start of delivery for barrel 1 yielded pointer position  
130° (1)

Start of delivery for barrel 5 yielded pointer position  
191° (2)

Value (1) subtracted from value (2) = 61° cam angle.

This means that the start-of-delivery spacing between barrel 1 and barrel 5 is 61° cam angle.

This value is noted down.



Then do the same with the other barrels, and enter the values in the test record.

The start-of-delivery spacing of the individual barrels is also adjusted by turning the tappet screw.

If the cam spacing is too great ( $61^\circ$ ), adjust by means of correspondingly thinner prestroke adjusting shims.

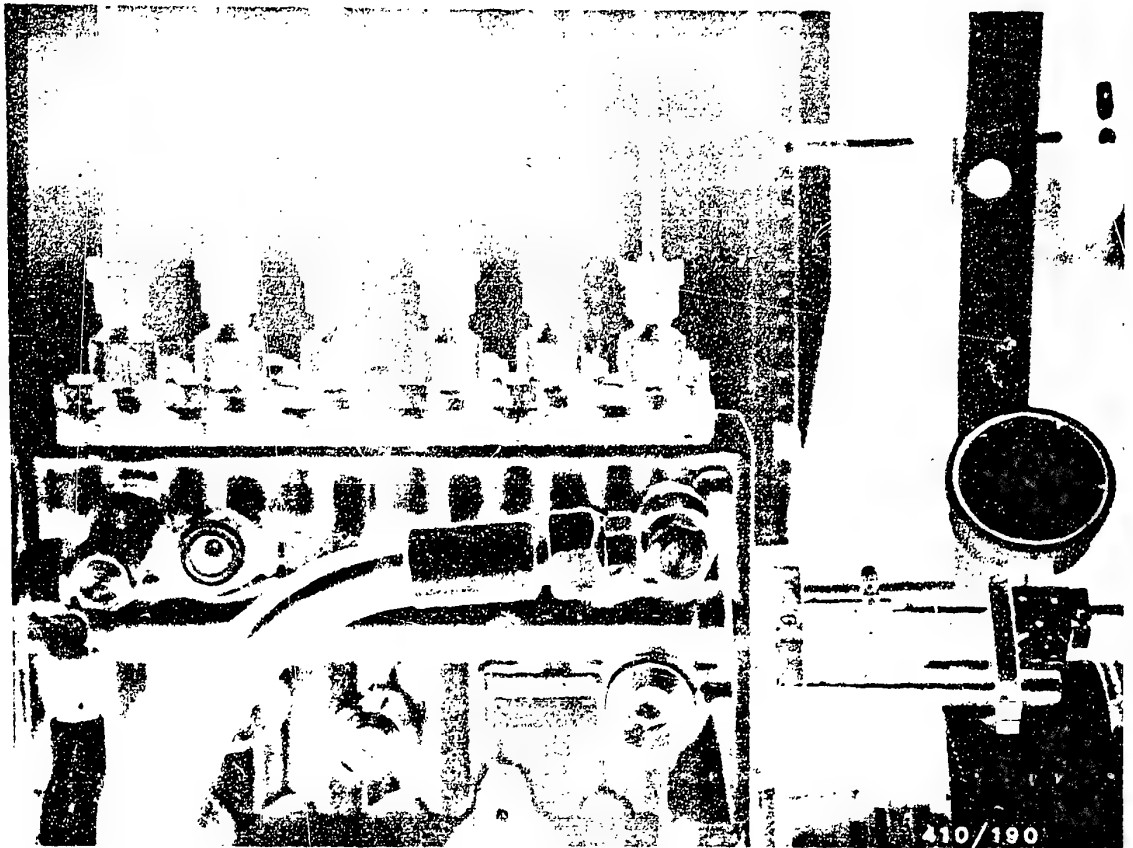
If the cam spacing is too small, use thicker prestroke adjusting shims.

After completing the adjustment of prestroke and start-of-delivery spacing, loosen again the locking screw on the control-rod-travel measuring device.

**F10**

Adjusting the start-of-delivery spacing  
Adjusting/testing PE(S)..P.. pumps





## 10. Checking and adjusting the basic setting

The overflow pipes of all calibrating nozzle holders are closed.

If scavenging of the suction gallery is specified for adjusting the injection pump, the calibrating oil return hose must be connected to the specified overflow valve (as per test specifications) at the threaded bore provided for this purpose.

Switch on injection-pump test bench and set the inlet pressure specified in the test-specification sheet. Heat up the calibrating oil until the inlet temperature specified in the test specifications is obtained.

**F11**

Basic setting

Adjusting/testing PE(S)..P.. pumps



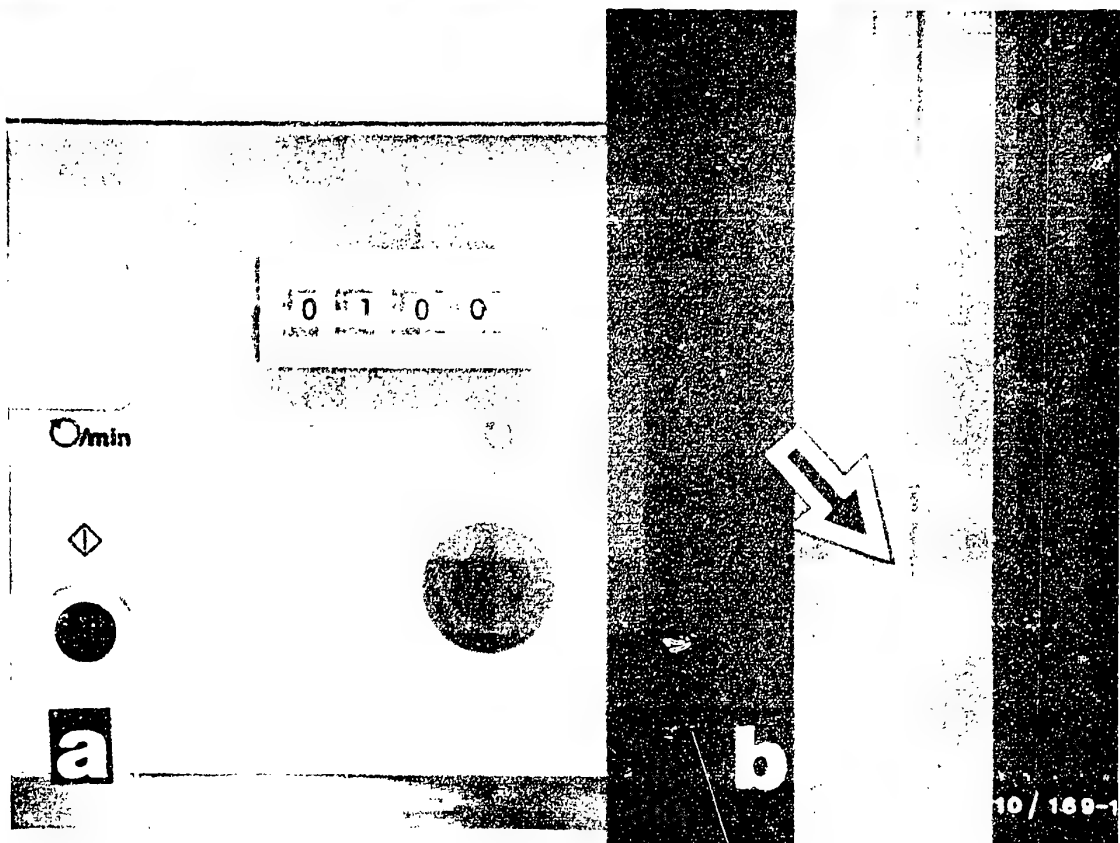
Slide the injection-pump control rod out of the shutoff position toward "max." until the control-rod travel specified in the test-specification sheet is obtained. In this position, fix the control rod on the control-rod-travel measuring device with clamping device. Drive injection pump at specified speed. Set stroke counter to "100" and switch on. The quantity of calibrating oil which is caught in the measuring glasses of the test bench is used in the first measurement only for wetting the measuring glasses. The measuring glasses are emptied again. The discharge time is 29 to 31 seconds. If the pause after discharging up to the next measurement is longer than 10 minutes, wet measuring glasses again.

**F12**

Basic setting

Adjusting/testing PE(S)..P.. pumps





Leave stroke counter at "100" and trigger.  
After the stroke counter has completed the measurement, read off the quantity of calibrating oil in each measuring glass and note down. A blue stripe, which is opposite the numbering on the measuring glass, is used for an accurate reading (see picture, arrow).  
If the measuring glass is wetted, light refraction at the surface of the liquid results in two superimposed points. Always read off the fuel delivery at the scale mark indicated by the two points.

**F13**

Basic setting

Adjusting/testing PE(S)..P.. pumps



The fuel delivery given in the test specifications is the average of all individual deliveries measured. Also establish whether the allowable dispersion given in the test specifications is exceeded. The dispersion indicates the difference between the largest and the smallest fuel deliveries.

Example:

Specified delivery = 12.1 - 12.3 cm<sup>3</sup>/100 strokes

Allowable dispersion = 0.3 cm<sup>3</sup>/100 strokes

Cylinder No.	1	2	3	4	5	6	Average
Delivery	12.4	12.2	12.5	12.3	12.5	12.4	12.38

Dispersion: 12.5 - 12.2 = 0.3 cm<sup>3</sup>/100 strokes

This setting is not allowable; the average of all cylinders is not between 12.1 and 12.3 cm<sup>3</sup>/100 strokes

Cylinder No.	1	2	3	4	5	6	Average
Delivery	12.4	12.2	12.0	12.3	12.1	12.4	12.23

Dispersion: 12.4 - 12.0 = 0.4 cm<sup>3</sup>/100 strokes.

This setting is not allowable; the dispersion is greater than 0.3 cm<sup>3</sup>/100 strokes.

**F14**

Basic setting

Adjusting/testing PE(S)..P.. pumps





Cylinder No.	1	2	3	4	5	6	Average
Delivery	12.4	12.2	12.2	12.3	12.1	12.4	12.26

Dispersion:  $12.4 - 12.1 = 0.3 \text{ cm}^3/100 \text{ strokes}$

This setting is allowable.

**F15**

Basic setting

Adjusting/testing PE(S)..P.. pumps





If, due to unallowable values, it is necessary to improve the setting of the injection pump, proceed as follows:

Switch off the pump test bench. Loosen hexagon nut of plunger-and-barrel assembly flanges. The fuel delivery of the individual plunger-and-barrel assembly is corrected by turning the barrel-and-valve assembly within the adjusting range of the slots. To do this, use wrench KDEP 2997.

After adjusting, re-tighten the hexagon nuts of the flange plunger-and-barrel assemblies to 40...45 Nm.

**F16**

Basic setting

Adjusting/testing PE(S)..P.. pumps



Then once again measure one hundred strokes at the specified speed. If the specified values are still not obtained, make correction again.

After the basic setting is completed, perform the measurement given beneath it in the test specifications at the specified speed and at the corresponding control-rod travel.

If the delivery specified in the test-specification sheet is not obtained, this may be due to the following causes:

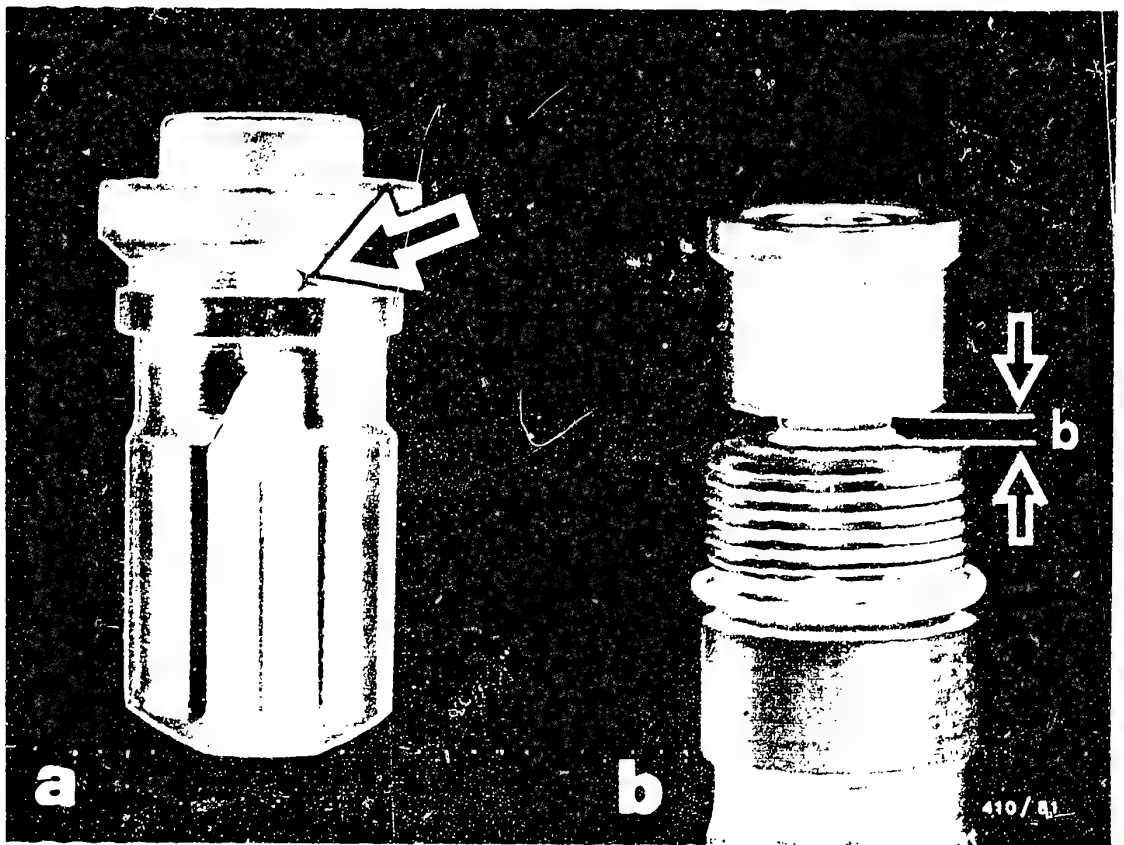
- + Use of incorrect or unserviceable plunger-and-barrel assemblies
- + Use of incorrect or unserviceable delivery valves
- + Incorrect delivery-valve springs and/or filler pieces in delivery-valve holder
- + Incorrect or unserviceable delivery-valve holders (unserviceable as a result of cavitation)
- + Incorrect setting of the delivery-valve spring pre-load, particularly in the case of injection pumps with torque-control delivery valves.

**F17**

Basic setting

Adjusting/testing PE(S)..P.. pumps





Torque-control delivery valves can be identified by the small bore (see picture a, arrow) between sealing cone and retraction collar of the valve cone. The adjusting dimension "b" (see picture b) for the spring preload of the delivery-valve spring is given in the test specifications under section C "Remarks".

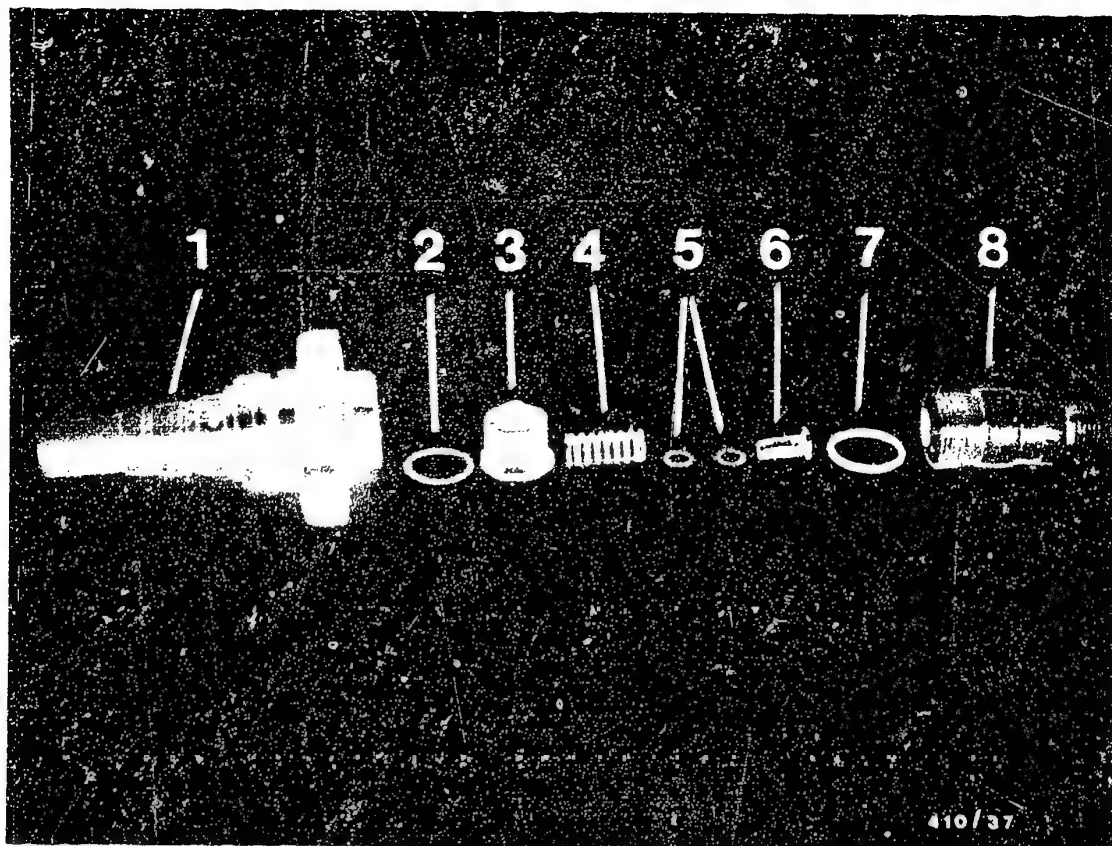
However, this dimension should only be used as a preliminary adjusting dimension; the precise thickness of shims under the delivery-valve spring is established by way of the fuel delivery. The following basic rule applies: The greater the spring preload, the greater the fuel delivery in the upper speed range.

**F18**

Basic setting

Adjusting/testing PE(S)..P.. pumps





- |                    |                           |
|--------------------|---------------------------|
| 1 = Pump barrel    | 5 = Shims                 |
| 2 = Gasket         | 6 = Filler piece          |
| 3 = Delivery valve | 7 = O-ring                |
| 4 = Valve spring   | 8 = Delivery-valve holder |

The preload of the delivery-valve spring is adjusted/changed as follows:

Unscrew delivery-valve holder and remove delivery-valve spring. Depending on the measurement result of the fuel delivery, insert thinner or thicker shim under valve spring in delivery-valve holder. Insert new O-ring.

**F19**

Basic setting

Adjusting/testing PE(S)..P.. pumps



Place valve spring on valve cone. Place shim and, if applicable, filler piece on spring. Screw delivery-valve holder with new seal ring back into pump housing. Tighten hexagon nuts to 40...45 Nm.

Repeat testing of fuel delivery. If necessary, correct again until the specified delivery is obtained.

Again remove the governor cover without parts which was mounted as a protective cover.

Only mount original governor cover if RQ or RQV governor is mounted.

If it is not intended to set the governor, re-mount supply pump, timing device, control-rod stop (manifold-pressure compensator) and control-rod screw plug, if applicable.

Remove pump from test bench.

**F20**

Basic setting

Adjusting/testing PE(S)..P.. pumps



## Viscosity test (continued)

Oil temperature in °C	Allowable discharge time (sec)
31	70.0 ... 73.5
32	69.5 ... 73.0
33	69.0 ... 72.5
34	68.5 ... 72.0
35	68.2 ... 71.5
36	67.8 ... 71.0
37	67.5 ... 70.5
38	67.0 ... 70.0
39	66.5 ... 69.5
40	66.0 ... 69.0

### Cleaning the viscosity test beaker

Do not clean the inside of the viscosity test beaker by polishing, but after each test wash out with benzine in order to prevent resin deposits in the outlet bore.

Never clean the outlet bore with a needle since score marks in the bore would falsify the measurement result due to a change in the flow conditions.

**A15**

General notes (calibrating oil)

Adjusting/testing PE(S)..A../PE(S)..P..



## 4. Test equipment

### 4.1 General

The setting and checking values given in the test specifications refer to precisely specified test equipment. The most important components of the test equipment are: calibrating nozzle-and-holder assembly, calibrating fuel-injection tubing and overflow valve.

Possible variants of such test equipment are listed in the following. The first-mentioned calibrating fuel-injection tubing and calibrating nozzle-and-holder assemblies represent the usual test equipment for the respective pump type. Different versions of test equipment are listed after.

The calibrating fuel-injection tubing and calibrating nozzle-and-holder assemblies which are to be used are strictly specified in the test specifications for each injection-pump assembly.

The test equipment also contains a list of the types of test bench which are approved for each size of pump. Failure to comply with these instructions will lead to serious setting errors on pumps and to incorrect test results.

Models of test bench which are not listed must not be used.

### 4.2 Condition of test equipment

The injection pressure of the calibrating nozzle-and-holder assemblies and the condition of the nipples of the calibrating fuel-injection tubing (use limit gauge) should be checked once a week, and no later than after testing 20 injection pumps.

If necessary, re-adjust opening pressure of nozzle holders and repair/replace fuel-injection tubing.

**A 16**

Test equipment

Adjusting/testing PE(S)..A../PE(S)..P..





# After-sales Service

## Technical Bulletin

Only for use within the Bosch organization. Not to be communicated to any third party.

### Injection-Pump Test Bench Conversion to Flywheel 1 686 609 057

40

VDT-I-400/1000 B  
2.1978

In order to mount the larger flywheel 1 686 609 057 (see also VDT-W-400/305) on the drive shaft of the injection-pump test benches EFEP 375.., 410.., 385.. and 390.., the suction line, discharge tubing and vacuum connections must be re-positioned. (Items 5, 6 and 7 in Figure 1)

#### 1. Removal of the connecting parts

##### 1.1 Test-oil inlet - Item 6:

Remove the hose fitting on the control valve; the fitting is accessible above the oil motor after taking off the rear wall of the test-bench housing. After unscrewing the 3 countersunk-head screws, the pipe bend together with the hose can be pulled out through the hole.

##### 1.2 Suction-line connector - Item 5:

After unscrewing the 3 countersunk-head screws, remove the pipe bend, loosen-off the hose connector and pull off the plastic hose.

##### 1.3 Vacuum connector - Item 7:

Unscrew the countersunk-head screws, loosen-off the hose connector and pull out the hose.

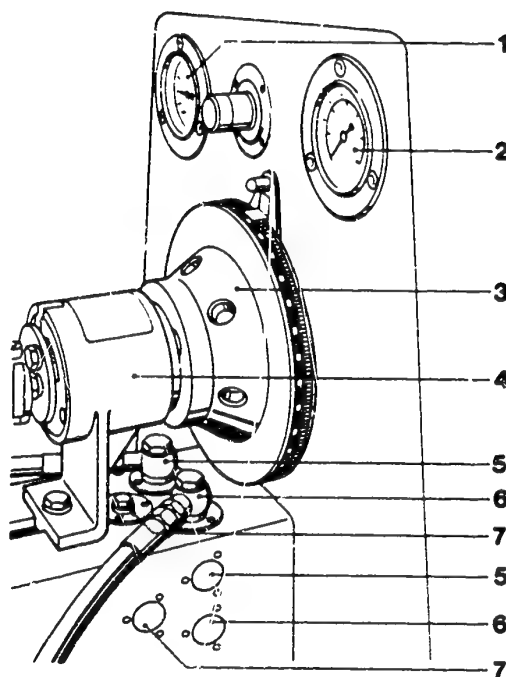


Figure 1 Front side of the upper part of the test bench

- 1 Thermometer
- 2 Pressure Gauge
- 3 Graduated disc
- 4 Backlash-free clutch
- 5 Suction-line connector
- 6 Pressure-line connector (Test-oil inlet)
- 7 Suction-line connector  
(Blank off when not used)

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Geschäftsbereich Kfz-Kundendienst, Kfz-Ausrüstung  
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N1

Technical Bulletin

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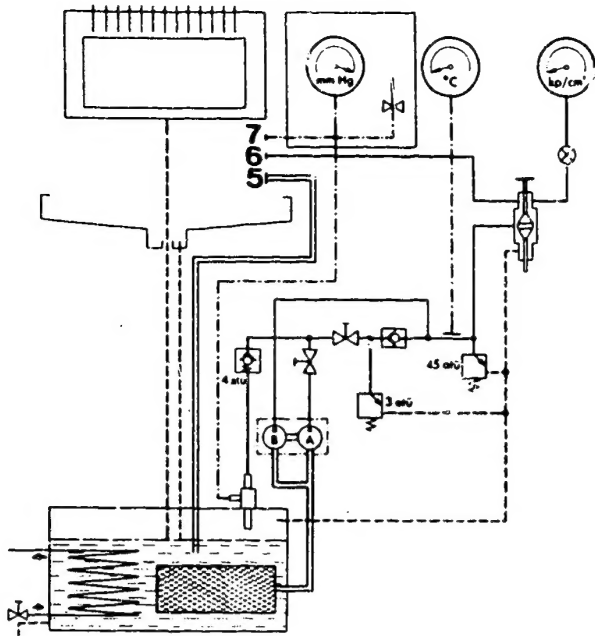


Figure 2 Line schematic

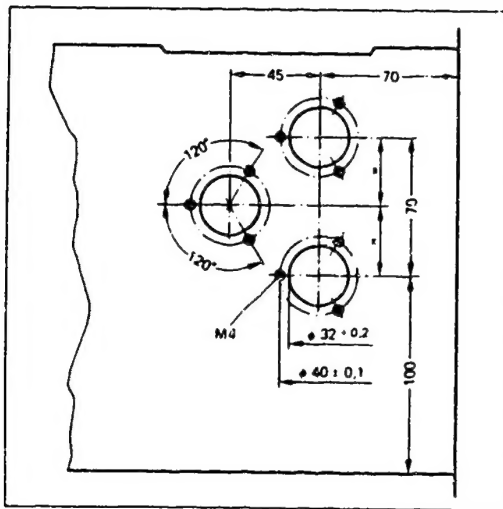


Figure 3 Drilling dimensions

## 2. Drilling the new conector openings

(Use flange as marking template)

The 32 mm dia. holes (cut using a spot facer), and the M 4 tapped holes, are to be located on the operating side of the test bench which experience has shown to be used the most. During drilling, beware of electric cables, it might even be advisable to lock the push-button switch and remove the fuses.



### 3. Modifying the pipe bends

Modify both pipe bends, for test-oil inlet and for suction-line connector, in accordance with Figure 4 so that they fit during reassembly. Shorten them as shown in Figure 4 and re-solder (brazed).

### 4. Reassembling the connecting parts

Assemble in the order given under 1, e.g. connect the hose which leads to item 6 with the pipe bend and insert it in the hole prepared; secure with the countersunk-head screws.

Items 5 and 6 in accordance with 1.  
Blank off the holes on the upper side with appropriate cover plates.

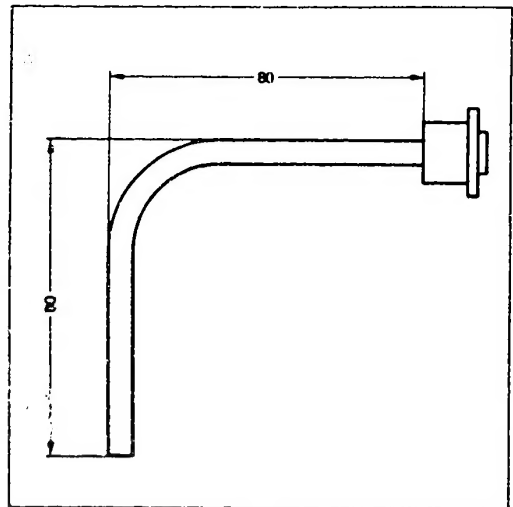


Figure 4 Modify pipe bend

### 5. Remove and replace the flywheel

The flywheel is secured to the drive shaft with hexagon-head screw, washer and keyway. After removing the multi-plate clutch, unscrew the hexagon-head screw and pull off the old flywheel.

The new flywheel is fitted in the reverse order. Check for true running (maximum deviation: 0.03 mm).



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Automotive Equipment - After-Sales Service  
Department for Technical Publications KH/VDT  
Postfach 50, D-7000 Stuttgart 1.

Published by: After-Sales Service Department for  
Training and Technology (KH/VSK). Press date: 3.1985.  
Please direct questions and comments concerning the  
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Microfilmed in the Federal Republic of Germany. Micro-  
photographié en République Fédérale d'Allemagne.

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